Exxon Valdez Oil Spill
Long-Term Monitoring Program (Gulf Watch Alaska) Final Report

Gulf Watch Alaska Program: Long-Term Monitoring of Marine Conditions and Injured Resources

Exxon Valdez Oil Spill Trustee Council Program 21120114
Final Report

Mandy Lindeberg, Rob Suryan
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Auke Bay Laboratories
17109 Point Lena Loop Road
Juneau, Alaska 99801

Katrina Hoffman, Donna Aderhold
Prince William Sound Science Center
1000 Orca Road
P.O. Box 705
Cordova, Alaska 99574

With contributions from M. Arimitsu, S. Baird, B. Ballachey, S. Batten, M.A. Bishop, J. Bodkin, H. Coletti, D. Cushing, S. Danielson, T. Dean, D. Esler, G. Esslinger, K. Holderied, R. Hopcroft, K. Iken, R. Kaler, K. Kloecker, B. Konar, K. Kuletz, E. Labunski C. Matkin, D. Monson, J. Moran, D. Olsen, C. Ostle, J. Piatt, B. Robinson, A. Schaefer, J. Straley, S. Traiger, and B. Weitzman

November 2023

Exxon Valdez Oil Spill
Long-Term Monitoring Program (Gulf Watch Alaska) Final Report

Gulf Watch Alaska Program: Long-Term Monitoring of Marine Conditions and Injured Resources

Exxon Valdez Oil Spill Trustee Council Program 21120114
Final Report

Mandy Lindeberg, Rob Suryan
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Auke Bay Laboratories
17109 Point Lena Loop Road
Juneau, Alaska 99801

Katrina Hoffman, Donna Aderhold
Prince William Sound Science Center
1000 Orca Road
P.O. Box 705
Cordova, Alaska 99574

With contributions from M. Arimitsu, S. Baird, B. Ballachey, S. Batten, M.A. Bishop, J. Bodkin, H. Coletti, D. Cushing, S. Danielson, T. Dean, D. Esler, G. Esslinger, K. Holderied, R. Hopcroft, K. Iken, R. Kaler, K. Kloecker, B. Konar, K. Kuletz, E. Labunski, C. Matkin, D. Monson, J. Moran, D. Olsen, C. Ostle, J. Piatt, B. Robinson, A. Schaefer, J. Straley, S. Traiger, and B. Weitzman

November 2023

Gulf Watch Alaska Program: Long-Term Monitoring of Marine Conditions and Injured Resources

Exxon Valdez Oil Spill Trustee Council Program 21120114
Final Report

Study History: The Gulf Watch Alaska program was initiated in 2012 in response to an invitation for proposals from the *Exxon Valdez* Oil Spill Trustee Council for a long-term monitoring program that would track the recovery of resources since the spill and assess how factors other than oil may inhibit full recovery. During the five-year funding cycle from 2012 through 2016, Gulf Watch Alaska included 15 scientific monitoring projects assessing environmental drivers, the pelagic ecosystem, the nearshore ecosystem, and lingering oil. Additionally, five administrative and data management projects were established to support the Gulf Watch Alaska program, including program integration and science synthesis, historic data retrieval and synthesis, data management, administration, and outreach. Many of the long-term monitoring projects incorporated into Gulf Watch Alaska were previously funded by the *Exxon Valdez* Oil Spill Trustee Council, with some originating prior to the spill in 1989 and representing > 40-year time series. Based on the success of the first five-year period, the Gulf Watch Alaska program was approved for funding by the *Exxon Valdez* Oil Spill Trustee Council to continue long-term monitoring for fiscal years 2017-2021. The 2017-2021 program included 12 scientific monitoring projects and two program management projects that were combined during the five-year period. In 2021, the *Exxon Valdez* Oil Spill Trustee Council supported funding the Gulf Watch Alaska program for 2022-2026, incorporating Herring Research and Monitoring projects into an expanded Gulf Watch Alaska Long-Term Research and Monitoring program.

Abstract: Gulf Watch Alaska was developed around three core ecosystem components: 1) Environmental Drivers – physical and biological oceanography to assess the effect of "bottom-up" changes in ocean productivity; 2) Pelagic – studies of forage fishes, seabirds, and whales to assess effects on higher trophic levels and the role of "top-down" predation; and 3) Nearshore – studies of subtidal and intertidal habitats and dependent species such as sea otters and marine birds. Sustaining and building on existing long-term datasets in *Exxon Valdez* oil spill-affected regions was also a central focus for the program. Field sampling began at a critical time to capture the 2014-2016 northeast Pacific marine heatwave and a subsequent, shorter duration heatwave in 2019. Investigators detected significant ecosystem change from the heatwaves that slowed or reversed recovery of oil spill injured resources. Investigators identified lingering oil remaining in Prince William Sound; however, its chronic impacts on wildlife have declined. More than 150 peer reviewed journal articles and book chapters have been published using Gulf Watch Alaska originated or historical data and more than 60 datasets were published online for public access in DataONE. Investigators gave more than 500 oral and poster presentations at

science conferences and public venues. Community outreach included visits, presentations, and information exchanges with spill-affected Native Alaskan villages and coastal communities, major contributions to the annual *Delta Sound Connections* periodical, and continuously updated website content. This program has improved our understanding of how long-term (e.g., climate) and short-term (e.g., heatwave) environmental change affects the Gulf of Alaska ecosystem and recovery of resources and services injured by the *Exxon Valdez* oil spill. Gulf Watch Alaska is uniquely positioned to assess recovery potential of resources still listed as injured by the Trustee Council, while also broadly contributing to state and federal resource management in the oil spill region.

Key words: Ecosystem, environmental drivers, herring, intertidal, marine heatwave, nearshore, oceanography, pelagic, Prince William Sound, program management, science coordination, science synthesis

Project Data: Data collected for Gulf Watch Alaska program projects that contributed to this report are available through the Alaska Ocean Observing System (AOOS) Gulf of Alaska data portal: http://portal.aoos.org/gulf-of-alaska.php#module-search?lg=5040a46e-25db-11e1-94b9-0019b9dae22b&page=1&tagId=Tag%3AEVOS+Gulf+Watch+Projects&q=&tags=Tag%3AEVOS+Gulf+Watch+Projects

The data may also be found through the DataONE earth and environmental data archive at https://search.dataone.org/#data and by selecting the Research Workspace under the Member Node filter.

The data custodian is Carol Janzen, Director of Operations and Development, Alaska Ocean Observing System, 1007 W. 3rd Ave. #100, Anchorage, Alaska 99501, 907-644-6703. janzen@aoos.org.

Data are archived by Axiom Data Science, a Tetra Tech Company, 1016 W. 6th Ave., Anchorage, Alaska 99501.

Citation:

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2023. Gulf Watch Alaska: Long-term monitoring of marine conditions and injured resources. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Gulf Watch Alaska Program: Long-Term Monitoring of Marine Conditions and Injured Resources

EXECUTIVE SUMMARY

The *Exxon Valdez* Oil Spill (EVOS) Trustee Council (EVOSTC) initiated funding for the Gulf Watch Alaska (GWA) long-term monitoring program in 2012 (McCammon et al. 2011). This final report summarizes the findings and activities of GWA during the second 5-year funding cycle, 2017-2021. GWA has three core ecosystem components focused on environmental drivers (physical and biological oceanography), pelagic ecosystems (forage fishes, seabirds, and whales), and nearshore ecosystems (subtidal and intertidal habitats, sea otters and marine birds) that include 13 projects, ten of which started before 2012 and several with data sets extending prior to the EVOS. During this second funding period, GWA improved integration among components and synthesized data to provide a greater understanding of how environmental change, including recent marine heatwaves, affect recovery potential of EVOS injured resources. Additionally, the program leveraged resources and fostered additional partnerships that greatly enhanced the overall contribution of EVOSTC funded monitoring for resource management in the spill-affected region. Collectively, this group of more than 35 scientists represents unsurpassed expertise and knowledge of the Gulf of Alaska (GOA) ecosystem and spill-affected resources.

The overarching goals of GWA were to:

A. Collect long-term ecological monitoring information from the GOA EVOS affected region.
B. Make monitoring data publicly available for use by stakeholders, managers, and facilitate synthesis efforts.
C. Assess monitoring data holistically in order to better understand the range of factors affecting individual species and the ecosystem.

Integrating numerous multi-disciplinary long term monitoring projects under GWA has proven highly successful in creating a mature, efficiently functioning program. GWA programmatic successes during the second five years include (but are not limited to):

- Collected five years of ecosystem data after a major marine heatwave, demonstrating slowed or reversed recovery trajectories for species still considered injured by the EVOS.
- Published more than 70 peer-reviewed papers, including one special issue journal.
- Published four science synthesis papers, one from each component of GWA, and another overarching paper describing how GOA ecosystems responded to recent heatwaves.
- Tripled annual contributions to the Gulf of Alaska Ecosystem Status Reports for the North Pacific Fisheries Management Council to help make science-based fishery management decisions.

- Published annual reports on the findings of each project within the GWA program (2017-2021).
- Maintained archives of all GWA products on the Research Workspace that is shared across multiple federal agencies, universities, and private organizations. The Research Workspace provides a collaborative site for all GWA program principal investigators (PIs) to share information and discuss findings.
- Annually contributed 47 data sets to the GOA Data Portal (http://portal.aoos.org/gulf-of-alaska.php). The Data Portal provides public and resource management agency access to GWA program data that are reviewed following quality assurance and quality control procedures and include federally compliant metadata.
- Published datasets with digital object identifiers (DOI) that are publicly available in the DataONE archive.
- Maintained the GWA program website (http://www.gulfwatchalaska.org/) where information is shared with the public. Additional non-technical articles for public outreach about GWA studies and findings included annual contributions to *Delta Sound Connections*, an online and print paper distributed during the summer tourist season.
- Conducted additional outreach activities within the spill-affected area including at local community meetings, presentations, and information exchanges, as well as school classroom visits.

Detailed findings are provided in individual final reports for each GWA project.

In 2021, the EVOSTC supported funding the GWA program for 2022-2026, incorporating Herring Research and Monitoring projects into an expanded Gulf Watch Alaska Long-Term Research and Monitoring program.

INTRODUCTION

The Gulf Watch Alaska (GWA) long-term ecosystem monitoring program was developed in response to Invitations for Proposals from the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) under the Focus Area "long-term monitoring of marine conditions and injured resources." The EVOSTC established the focus area in the 2010 invitation after more than two decades following the March 1989 *Exxon Valdez* oil spill (EVOS) because the unexpectedly long-term oil spill had greater influences on population dynamics than the acute effects of the spill (Peterson et al. 2003, Esler et al. 2018) and it became apparent that the ecosystem can undergo profound changes that may hinder a return to pre-spill conditions (EVOSTC 2015). The timing of the EVOSTC invitation was fortuitous in establishing GWA in 2012, a couple of years prior to the largest marine heatwave in recent history (Hobday et al. 2018).

The 2014-2016 Pacific marine heatwave (PMH) lasted nearly two full years and caused disruptions and large-scale mortality events throughout the Gulf of Alaska (GOA) food web (Walsh et al. 2018, Barbeaux et al. 2020, Piatt et al. 2020). A subsequent marine heatwave in

2019 prolonged the effects of the first heatwave for some species (Arimitsu et al. 2021, Suryan et al. 2021). Species that are still listed as not recovered over 30 years after the EVOS were in similar or worse recovery state after the PMH. The abundance of resident killer whales (*Orcinus orca*; project 21120114-N) and Pacific herring (*Clupea pallasii*; Herring Research and Monitoring [HRM] program 21120111) declined during the marine heatwave and had not returned to pre-heatwave levels by 2021. Pigeon guillemots (*Cepphus columba*) and Kittlitz's (*Brachyramphus brevirostris*) and marbled (*B. marmoratus*) murrelets continued their long-term decline in the region (projects 21120114-E and 21120114-M).

The 2010 and 2015 Invitations requested ecosystem component projects related to environmental drivers (monitoring oceanographic conditions), pelagic species (killer and humpback whales [*Megaptera novaeangliae*], marine birds, and forage fish), and nearshore benthic ecosystems (habitats and species in the intertidal zone) to meet the Trustee Council's goals to monitor the recovery of resources from the initial injury and monitor how factors other than oil may inhibit full recovery or adversely impact recovering resources. As required by the invitations, we established a small and efficient administrative structure to manage funds, projects, and reporting requirements, including: (1) Program leadership to communicate with EVOSTC staff, be responsive to the Trustee Council's objectives and requirements, facilitate the most cost-effective and scientifically-supported stream of funding in a manner that minimizes administrative costs; (2) science coordination to integrate data from individual projects to inform the program as a whole; (3) a program level Science Review Panel (SRP) to review projects and give guidance and oversight on the program's design and implementation as well as scientific peer review of final reports; (4) a plan for individual project compliance with reporting and data submission policies; (5) a structure to establish contracts and distribute funds to investigators outside of Trustee agencies; and (6) a public outreach plan.

The design, integration, and efficient operation of GWA and its partners ensured that it was uniquely poised to assess the ecosystem impacts of the PMH in the GOA and assess the recovery potential of EVOS-injured resources. The following is a brief summary of each GWA component and associated projects.

Integrated program management and administration

Program coordination and science synthesis (GWA Program Management I) and Program administration, logistics, and outreach (GWA Program Management II)
Project 21120114-A&B

The program management projects were combined for reporting purposes to demonstrate the close coordination between the managing entities: the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and the Prince William Sound Science Center (PWSSC). NOAA NMFS provided program coordination within and external to GWA (including EVOSTC funded and non-EVOSTC funded programs), reporting,

and oversight of science synthesis of data collected under the long-term monitoring program. PWSSC served as the administrative lead and fiscal agent for GWA, including administering non-Trustee Agency subawards, engaging with EVOSTC staff, Trustees, and Public Advisory Committee (PAC) members, and outreach and community involvement activities.

Environmental Drivers monitoring component

The environmental drivers component of the GWA program provided spatial and temporal understanding of change in the physical and chemical environment. Combined with measurements and analyses that incorporate other broad-scale ocean, atmosphere, and cryosphere datasets, the environmental Drivers component provides mechanistic understandings of environmental perturbations such as El Niño, the recent Northeast Pacific marine heatwaves, longer-term trends of a warming climate, and altered species distributions and interactions. This component consists of five interconnected projects distributed across the spill-impacted region of the GOA.

GAK-1 monitoring
Project 21120114-I

This project, led by the University of Alaska Fairbanks (UAF), continued a now over 50-year time series at hydrographic station GAK-1 at the entrance to Resurrection Bay and monitors five important Alaska Coastal Current ecosystem parameters.

Seward Line monitoring
Project 21120114-L

This project, led by UAF, continued a now 25-year multi-disciplinary oceanographic observations along a 150-mile cross shelf transect south of Seward to determine the physical-chemical structure and the distribution and abundance of phytoplankton, microzooplankton, mesozooplankton, seabirds and marine mammals in the GOA.

Oceanographic conditions in Prince William Sound
Project 21120114-G

This project, led by PWSSC, continued physical and biological measurements to assess trends in the marine environment and bottom-up impacts on the marine ecosystems of Prince William Sound (PWS) and includes several time series initiated prior to or soon after EVOS.

Oceanographic monitoring in Cook Inlet
Project 21120114-J

This project, led by NOAA Kasitsna Bay Laboratory and the Kachemak Bay National Estuarine Research Reserve (KBNERR), continued oceanographic and plankton surveys conducted from shipboard and shore-based operations in lower Cook Inlet and Kachemak Bay to provide

information on the seasonal, inter-annual, and spatial variability in marine conditions that impact nearshore and pelagic species injured by EVOS.

Continuous plankton recorder
Project 21120114-C

This project, led by the Marine Biological Association (MBA), maintained the Continuous Plankton Recorder (CPR) transect which provides a record of taxonomically resolved, seasonal, near-surface zooplankton and large phytoplankton abundance across the GOA shelf from lower Cook Inlet into the open GOA.

Pelagic Ecosystem monitoring component
The pelagic ecosystem component monitored key pelagic species groups in PWS using five projects focused on killer whales, humpback whales, forage fish, and marine birds. The two over-arching questions for the pelagic component were: (1) What are the population trends of key pelagic species groups in PWS? and (2) How do predator-prey interactions contribute to underlying changes in the populations of pelagic predators in PWS?

Long-term killer whale monitoring
Project 21120114-N

This project, led by North Gulf Oceanic Society (NGOS), continued a 38-year killer whale monitoring program that was initiated in PWS five years prior to the EVOS and focused on the recovery of the AB resident pod and the threatened and not recovering AT1 transient pod of killer whales.

Humpback whale predation on herring
Project 21120114-O

This project, led by NOAA NMFS and University of Alaska Southeast (UAS) was part of the integrated predator-prey (IPP) survey and continued to evaluate population changes and the impact by humpback whale foraging on Pacific herring populations in PWS.

Forage fish distribution and abundance
Project 21120114-C

This project, led by the U. S. Geological Survey (USGS) Alaska Science Center (ASC), was part of the IPP survey and continued fall forage fish surveys in PWS when forage fish energy is maximized while marine birds and humpback whales are provisioning for the upcoming winter, and also supported the Institute for Seabird Research and Conservation (ISRC) to continue a 26-year time series of forage fish availability to nesting seabirds on Middleton Island in the GOA offshore of PWS.

Prince William Sound marine bird population trends
Project 21120114-M

This project, led by the U. S. Fish and Wildlife Service (USFWS), continued surveys to monitor abundance of marine birds in PWS during summer, contributing to a 32-year time series that began the year of EVOS to evaluate population trends and recovery of species in oiled and unoiled areas of PWS. The project also included marine bird and mammal surveys along the Seward Line as part of the NGA-LTER program.

Winter habitat use and distribution of seabirds in Prince William Sound
Project 21120114-E

This project, led by PWSSC, continued a 14-year time series of marine bird abundance and habitat associations during fall and winter and was part of the IPP survey.

Nearshore Ecosystem monitoring component

Nearshore systems in the Gulf of Alaska
21120114-H

The nearshore ecosystem component, composed of one integrated project led by the National Park Service (NPS), USGS ASC, UAF, NOAA NMFS, and USFWS, investigated and monitored the nearshore environment of the greater EVOS area, providing ongoing evaluation of the status of more than 200 species, including many of those recovering from EVOS. Foundational questions addressed by the nearshore component included: (1) What are the spatial and temporal scales over which change in nearshore ecosystems is observed? (2) Are observed changes related to broad-scale environmental variation, or local perturbations? (3) Does the magnitude and timing of changes in nearshore ecosystems correspond to those measured in pelagic ecosystems?

Lingering Oil monitoring component

Tracking oil levels and weathering
Project 21120114-P

This project is designed to monitor locations where oil spilled from the *Exxon Valdez* has been known to linger. It adds to a series of EVOSTC studies that have documented the presence of oil, and its distribution, volume, area, and weathering rate. This previous EVOSTC-funded work demonstrated that, on some beaches, subsurface oil persisted in a relatively unweathered state and this persistence occurred over a longer than expected time period. The intent of the current study was to determine if oil remains in these locations.

OBJECTIVES

The program had five primary objectives:

1. Sustain and build upon existing time series in the EVOS-affected regions of the Gulf of Alaska (GOA).
2. Provide scientific data, data products, and outreach to management agencies and a wide variety of users.
3. Develop science synthesis products to assist management actions, inform the public and guide monitoring priorities for the next 15 years.
4. Continue to build on collaborations between the GWA and HRM programs, as well as other Trustee program focus areas including the data management program, lingering oil and potential cross-program publishing groups.
5. Leverage partnerships with outside agencies and groups to integrate data and expand capacity through collaborative efforts.

METHODS

The FY17-21 Invitation for Proposals (EVOSTC 2015) included mandatory and preferred requirements for the long-term monitoring program. These requirements included:

- Focus within the oil spill-affected area.
- Responsiveness to the call for the long-term monitoring of marine conditions and injured resources program as described in the invitation.
- Compliance with EVOSTC's founding documents, reporting policies, and procedures.
- An administrative structure to manage funds and projects.
- Communication with EVOSTC through a team leader to work with and be responsive to EVOSTC's objectives and requirements, and facilitate cost-effective and scientifically-supportive funding across the program.
- A program lead capable of integrating data from all individual program projects.
- A program science panel to review projects and provide guidance and oversight on the direction of the program.
- Commitment to make all data, documents, and annual and final reports available electronically to the public.
- A process for providing scientific peer review for approval of final reports.
- A plan for ensuring individual project compliance with reporting and data submission and quality policies.
- Realistic and detailed timelines and milestones for individual projects and the overall program.
- Credible, feasible, and detailed administrative structure and scientific implementation
- A public outreach plan focused on providing information to Trustee Agencies for use in their respective outreach and education materials.
- Continual reassessment of the program's progress and relevancy.
- Demonstrated understanding and synthesis of scientific literature and recognition of available research infrastructure.

- Demonstrated effective and balanced use of funds.
- Detailed plans for local and native community involvement and public outreach.

The methods used to meet the GWA program's objectives are presented in detail in each of the project reports and summarized briefly here.

The scope of the GWA program is inclusive of all components—environmental drivers, pelagic, nearshore, and lingering oil—and administrative projects associated with the program. The study region included the EVOS-affected area, specifically the northern GOA, PWS, Kenai Fjords, lower Cook Inlet, and the Katmai Coast in Shelikof Strait (Fig. 1).

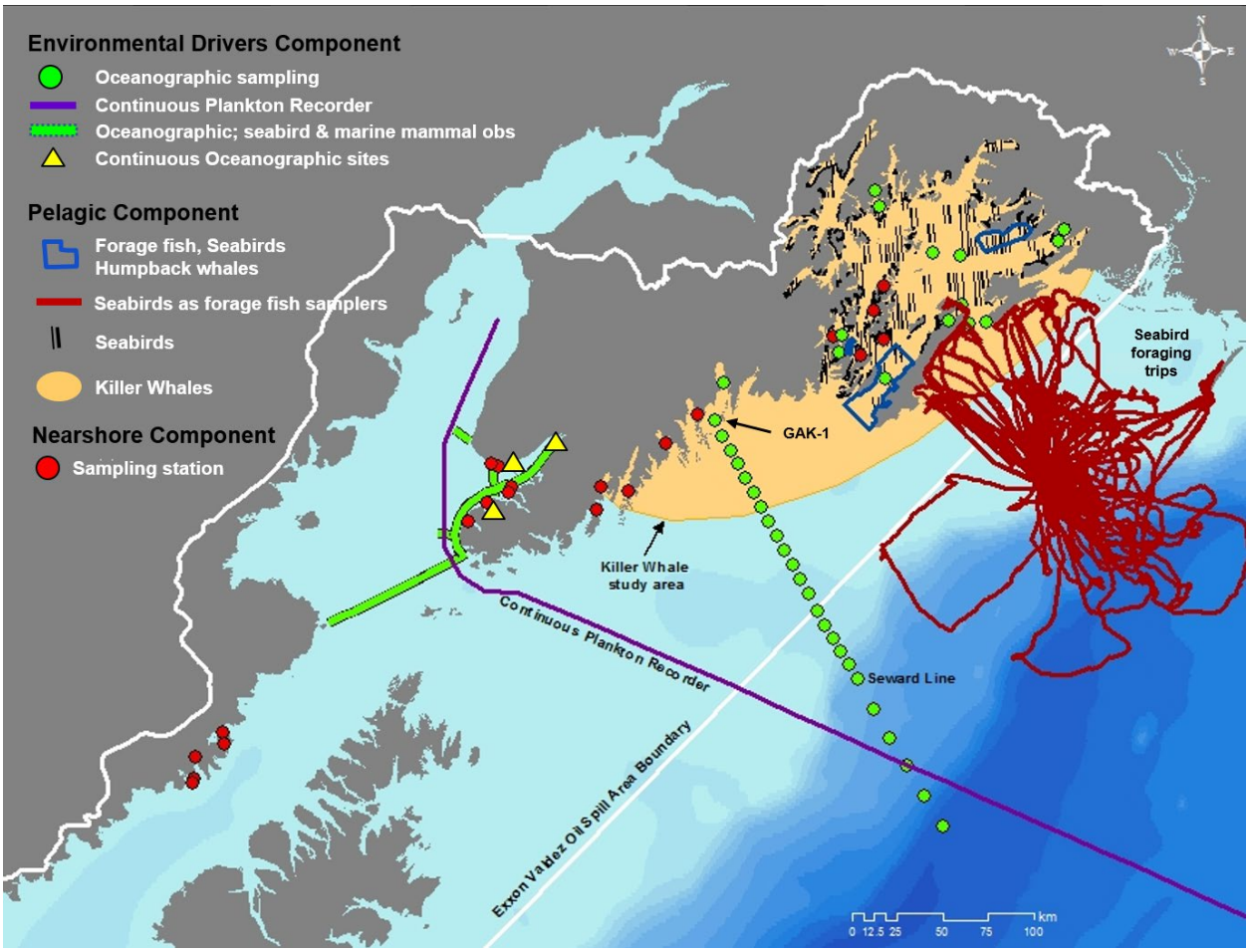

Figure 1. Gulf Watch Alaska long-term monitoring program study area within the Exxon Valdez oil spill affected area showing the approximate locations of projects in environmental drivers, nearshore, and pelagic components.

The GWA program team developed an organizational structure (Fig. 2) to meet EVOSTC requirements for the long-term monitoring program and to meet the GWA objectives. As a self-managed program, an efficient and dedicated team maintained high quality science, made data publicly available, synthesized data collected by the program, and communicated relevant results to resource managers and the public.

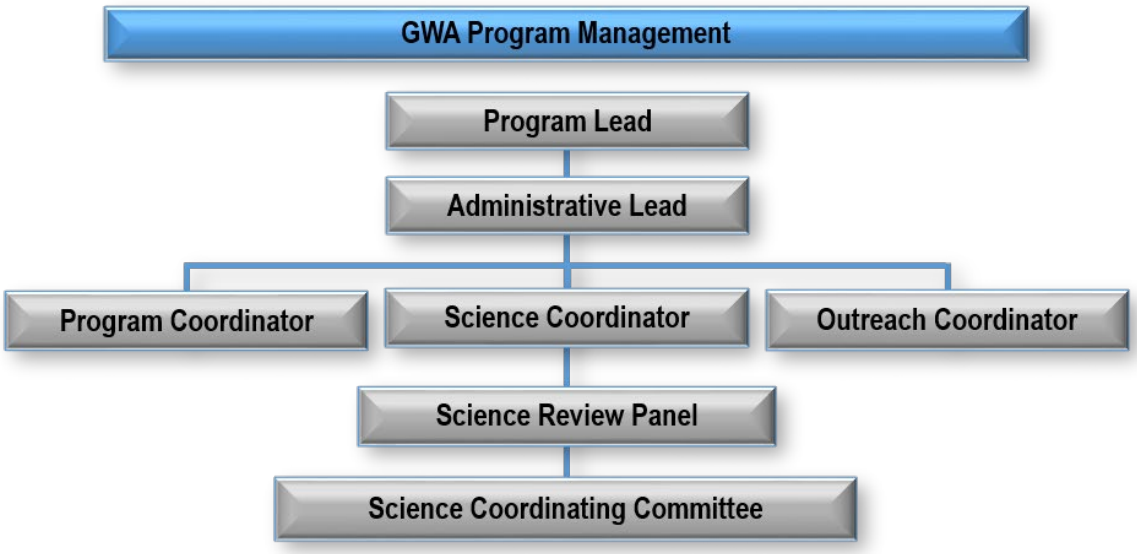

Figure 2. Organizational structure for the Gulf Watch Alaska (GWA) program during the fiscal years 2017-2021 funding cycle.

The program management team (PMT, Lindeberg, Hoffman, Suryan, Aderhold) worked with the component projects with the aid of a science coordinating committee (component leads; Fig. 2). The science coordinating committee provided internal oversight, coordination, and review of program deliverables; supported data management; and aided the program management team in program-level decision-making. Science coordinating committee members also took lead roles in the synthesis workshop and subsequent report and publications initiated in year 8 of the program.

In all, the GWA program included 13 projects, representing administration, monitoring, and synthesis (Table 1). PIs included in the GWA program were experts in their field of study with knowledge of the northern GOA, the spill, and EVOSTC requirements. The lingering oil focus area was a separate part of EVOSTC's FY17-21 Invitation for Proposals (EVOSTC 2015) and GWA PIs proposed the project during the FY17-21 period. Once funded, the project was added to the GWA program.

Table 1. Projects included in the Gulf Watch Alaska long-term monitoring program during the FY17-21 funding cycle.

Project Title (Number)	Brief Project Description (Lead Organization)[1]
Administrative, Data Management, and Synthesis Projects	
Synthesis, coordination, administration, logistics, and outreach (21120114-A & B)	Initiated as two projects and combined at the request of the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) Science Panel, the project was co-led by NOAA NMFS and PWSSC. The project led and coordinated monitoring projects within the program, supported synthesis of information across projects and components, administered funds and reporting under the NOAA grant for non-Trustee organizations, coordinated logistics and travel for annual meetings and the science review panel, and performed public outreach activities for the program.
Environmental Drivers Component Projects	
Continuous plankton recorder (21120114-D)	A device collected plankton data along the shipping route through the northern Gulf of Alaska (GOA) into Cook Inlet, monthly between April and September 2002-2021 (Marine Biological Association).
Long-term monitoring of oceanographic conditions in Prince William Sound (21120114-G)	Monitoring oceanography with a profiling mooring and cruise sampling in Prince William Sound (PWS), 2009-2021 (PWSSC).
GAK-1 (21120114-I)	GAK-1 mooring is located on the GOA shelf outside Resurrection Bay and has been recording oceanographic data for more than 50 years, 1970-2021 (UAF).
Long-term monitoring of oceanographic conditions in Cook Inlet and Kachemak Bay (21120114-J)	Monitoring oceanography in lower Cook Inlet and Kachemak Bay which is downstream of

Project Title (Number)	Brief Project Description (Lead Organization)[1]
	GAK-1 and Seward Line, 2001-2021 (NOAA and KBNERR).
Seward Line (21120114-L)	An oceanographic transect extending from GAK-1 to beyond the edge of the GOA continental shelf, 1998-2021 (UAF).
Pelagic Ecosystem Component Projects	
Forage fish distribution, abundance, and body condition (21120114-C)	Uses acoustics, seabird diet studies, and integrated predator and prey surveys to understand forage fish availability in the Gulf of Alaska and PWS, 2012-2021 (USGS).
Prince William Sound late fall/winter seabird abundance (21120114-E)	Evaluates the importance of PWS to overwintering marine birds and estimates population trends, 2007-2021 (PWSSC).
Prince William Sound marine bird population trends (21120114-M)	Continuation of summer surveys in PWS to estimate marine bird populations and trends over time following the injury of marine birds from the spill, 1972-2021 (USFWS).
Killer whale monitoring (21120114-N)	Continuation of injured killer whale pod and population monitoring in PWS and Resurrection Bay, 1984-2021 (NGOS).
Humpback whale predation on herring (21120114-O)	Evaluates the potential role of humpback whales in the lack of recovery of herring populations in PWS, 2006-2021 (NOAA and UAS).
Nearshore Ecosystem Component Projects	
Nearshore benthic systems in the Gulf of Alaska (21120114-R)	Sampling nearshore ecosystems in PWS, Kenai Fjords, Kachemak Bay, and Katmai, 1993-2021 (NPS, USGS, UAF, NOAA NMFS, and USFWS).

Project Title (Number)	Brief Project Description (Lead Organization)[1]
Lingering Oil Component Projects	
Tracking oil levels and weathering in Prince William Sound (21120114-P)	Continued monitoring of subsurface oil at select beaches in PWS, 2001, 2003, 2005, 2015, and 2021 (NOAA NMFS).

1 Organizations leading Gulf Watch Alaska program projects included the following, in alphabetical order: Kachemak Bay National Estuarine Research Reserve (KBNERR), Marine Biological Association (MBA), National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), National Park Service (NPS), North Gulf Oceanic Society (NGOS), Prince William Sound Science Center (PWSSC), University of Alaska Fairbanks (UAF), University of Alaska Southeast (UAS), U. S. Fish and Wildlife Service (USFWS), and U. S. Geological Survey (USGS).

Objective 1: Sustain and build upon existing time series in the EVOS-affected regions of the GOA.

Sustaining and building on existing time series in the EVOS-affected regions of the GOA was the heart of the GWA program. Numerous projects in the GWA program began before or in response to EVOS and are critical for understanding ecosystem impacts on EVOS injured resources. A full description of project methods can be found in the project final reports.

Environmental Drivers monitoring component

Continuous plankton recorder

CPR surveys have taken place in the northern GOA since 2000 (Ostle and Batten 2023). Transects extended across the GOA into Cook Inlet monthly from April to September via ships of opportunity (Fig. 1). CPRs recorded temperature and collected phytoplankton and zooplankton that were identified in laboratory analysis following each transect. A full description of the CPR instrument and sampling is provided in Batten et al. (2003), and Richardson et al. (2006).

Oceanographic conditions in Prince William Sound

Oceanographic monitoring in PWS included an autonomous moored profiler and vessel-based surveys in four bays in PWS that have been a focus of prior EVOSTC-funded research, as well as Hinchinbrook Entrance, Montague Strait, and central PWS (Fig. 1; Campbell 2023). The profiler collected conductivity and temperature at depth (CTD), nitrate, fluorescence, turbidity, and plankton (via a camera) data. Each vessel-based station included a CTD cast, water samples for nutrient and chlorophyll-a analysis, and a zooplankton tow (a 202 μm mesh, 60 cm diameter bongo net). Two stations were sampled in each of the bays: one near the head where juvenile herring are more frequently encountered, and one in more open waters at the mouth of the bay

where older age classes are more common. The timing of the surveys was structured around the "productivity season" to attempt to capture the spring and autumn blooms (i.e., pre-bloom, bloom, and post-bloom).

GAK-1 monitoring

Hydrographic measurements at the Gulf of Alaska 1 (GAK-1) mooring, located near the mouth of Resurrection Bay (Fig. 1) began in 1970, celebrating 50-years of monitoring during this funding cycle (Danielson 2023). The mooring records hourly temperature and salinity measurements obtained by moored instruments at six depths distributed over the water column. The mooring data are complimented with quasi-monthly CTD casts. GAK-1 is the only station in the GOA that measures both salinity and temperature over the 250 m deep water column. Nutrient, chlorophyll, and zooplankton sampling at GAK-1 has occurred since 1997 with support from the Seward Line sampling.

Oceanographic monitoring in Cook Inlet and Kachemak Bay

Scientists conducted oceanographic surveys in lower Cook Inlet and Kachemak Bay along with shore-based oceanographic data collection (Fig. 1; Holderied et al. 2023). Outer Kachemak Bay and lower Cook Inlet transects were surveyed quarterly and the mid-Kachemak Bay transect was surveyed monthly. Oceanographic data were collected at stations with CTD profilers. Plankton sampling was conducted at three of the stations along each transect. To provide more temporal resolution, continuous oceanographic measurements were made year-round at the KBNERR's system-wide monitoring program water quality stations located at the Seldovia and Homer harbors as well as in ice-free months from a buoy in Bear Cove near the head of Kachemak Bay.

Seward Line monitoring

The Seward Line program consisted of 13 primary and 9 secondary stations along the Seward Line, and 12 stations in PWS (eastern PWS stations were added in 2012; Fig. 1) sampled in May and early September from the UAF vessel *Sikuliaq* or USFWS vessel *Tiglax* (Hopcroft et al. 2023). Beginning in 2014, two stations were added to the offshore end of the line to ensure coverage of the oceanic end of the coastal ecosystem. Sampling was expanded in 2017 to include a cruise in July and two additional survey lines (off Kodiak and the Copper River Delta) when the Northern Gulf of Alaska Long Term Ecological Research (NGA LTER) program was funded by the National Science Foundation (NSF) with the Seward Line as a centerpiece. Oceanographic sampling methodology has remained stable since sampling began in the fall of 1997 (i.e., Weingartner et al. 2002). Seabird and mammal observations were made during transits between stations as part of the PWS marine bird population trends project (21120114-M; see below).

Pelagic Ecosystem monitoring component

Forage fish distribution and abundance

Forage fish surveys and sample collection efforts were focused in PWS and extended to the offshore region within a 100 km radius of Middleton Island (Fig. 1; Arimitsu et al. 2023). IPP surveys were conducted in collaboration with the humpback whale (project 21120114-O) and fall/winter marine bird (project 21120114-E) projects each year during the last two weeks of September. Researchers collected acoustic backscatter, trawl, and marine habitat data and concurrently conducted surveys for marine birds along fixed transect lines within three sub-regions. A second vessel was used to assess humpback whale abundance and collect whale tissue and prey samples. Middleton Island seabird diet sampling included collecting regurgitated food samples from adult and/or nesting black-legged kittiwakes (*Rissa tridatyla*) and rhinoceros auklets (*Cerorhinca monocerata*). The team also conducted boat-based sampling of forage fish in PWS to validate and estimate errors in fish school identification by aerial observers during surveys conducted by the HRM program. Summer acoustic-trawl surveys conducted during 2014-2016 were repeated in 2019 to assess interannual variability in forage fish acoustic biomass indices (Arimitsu and Piatt 2014).

Winter habitat use and distribution of seabirds in Prince William Sound

Since 2012, marine bird surveys took place in PWS during the nonbreeding season (September through March) onboard regularly scheduled research cruises sponsored by EVOSTC, the Alaska Department of Fish and Game, and Ocean Tracking Network maintenance cruises (Fig. 1; Schaefer and Bishop 2023). The seabird community in PWS changes dramatically between summer and winter and these surveys track the abundance, distribution, and habitat of the marine bird community present during the EVOS. This project was also one of three projects with the forage fish project (21120114-C) and the humpback whale project (21120114-O) involved in the IPP survey to evaluate forage fish, marine birds, and humpback whales.

Prince William Sound and Gulf of Alaska marine bird population trends

USFWS has conducted summer marine bird abundance surveys in PWS since 1972 (Fig. 1; Kaler et al. 2023). Four surveys were completed before the spill and 14 surveys after through 2022. Surveys were conducted throughout PWS during even numbered years; however, the global coronavirus pandemic prevented surveys in 2020 and 2021, so the 2022 survey, conducted during EVOSTC's approved no cost extension, is included in the final report results (Kaler et al. 2023). This study was designed to monitor marine bird populations of PWS to assess recovery of species affected by the EVOS by comparing trends in abundance of injured species between oiled areas and unoiled areas. During the FY17-21 reporting period, EVOSTC funded bird and mammal observer participation in the NGA-LTER surveys of the northern GOA associated with the Seward Line. No Seward Line/NGA-LTER observations occurred during spring 2020 due to Covid-19 restrictions.

Long-term killer whale monitoring

Population monitoring of killer whales in PWS, Resurrection Bay, and adjacent waters has occurred annually since 1984 (Fig. 1; Matkin et al. 2023). This project used photo-identification methods to monitor changes in resident killer whale pods. Killer whales were found visually, or by listening for calls with a hydrophone, or by responding to VHF radio calls from other vessel operators. Diet studies of killer whales were conducted by collecting fish scales or pieces of flesh from prey where whale kills and feces were observed. Project team members also examined the year-round distribution of killer whales in the northern GOA using passive acoustic recordings in Resurrection Bay and at Hinchinbrook Entrance and Montague Strait in PWS. During the FY17-21 period, the team tested the use of drones for obtaining images suitable for photogrammetry measurements of health metrics.

Humpback whale predation on herring

Studies of humpback whale predation on herring in PWS began in 2007 after scientific investigators collaborated to integrate information and identify factors contributing to the lack of recovery of Pacific herring following EVOS (Fig. 1). Humpback whale abundance and foraging patterns were monitored within PWS annually during this funding period (Moran et al. 2023). Individual whales were identified based on photographs of tail fluke patterns. Photographs were used to estimate survival, emigration, and abundance within PWS. Whale prey were identified by direct observations of prey being consumed, collection of prey remains after feeding, and visual interpretation of the prey fields observed on a dual 50/200kHz frequency echo sounder. Biopsies of humpback whale skin and whole prey species were collected for bulk stable carbon and nitrogen isotopic analysis to independently estimate whale diets based on trophic level. Energy content of humpback whale prey were measured from each survey to evaluate changes in prey quality over time. This project was also one of three projects (along with the forage fish project (21120114-C) and the fall and winter marine bird project (21120114-E)) involved in the IPP survey to evaluate forage fish, marine birds, and humpback whales.

Nearshore Ecosystem monitoring component

Nearshore systems in the Gulf of Alaska

The nearshore ecosystem project was designed to detect changes in abundance and distribution of numerous nearshore species, and to lend insight into underlying drivers of that change, including the relative influences of oil spill injury versus other natural or anthropogenic effects (Coletti et al. 2023). The project team conducted nearshore marine ecosystem monitoring in four regions within the spill-affected area of the northern GOA (Fig. 1): western Prince William Sound (WPWS), Kenai Fjords National Park (KEFJ), Kachemak Bay (KBAY), and Katmai National Park and Preserve (KATM). The nearshore monitoring program focused on sampling numerous ecosystem components in the GOA that are both numerically and functionally important, including kelps (and other marine algae), seagrasses, marine intertidal invertebrates, marine birds, black oystercatchers, sea otters, and physical properties. The nearshore monitoring

was carefully designed, with coordinated sampling of all metrics, to provide insights into drivers of change observed at different spatial and temporal scales.

Lingering Oil monitoring component

Tracking oil levels and weathering

The overall goal of this lingering oil project was to extend previous efforts to track *Exxon Valdez* oil levels and weathering in PWS since the onset of the spill (Heintz et al. 2023). The main objectives were to determine the probability of encountering oil on five beach segments previously known to harbor lingering oil and compare these probabilities to previous surveys. A lingering oil survey team, using established techniques, revisited a small set of the worst-case sites in PWS where sequestered oil was known to persist. Sampling incorporated a stratified random design that allowed for estimating the probability of encountering oil in different sections of each beach segment, as well as the percentage of lightly oiled, moderately oiled, and highly oiled residues in relation to previous surveys.

Integrated program management and administration

Program Management I and Program Management II

The program management project (Lindeberg et al. 2023) provided oversight by the leadership team that was critical for the monitoring projects to operate as an integrated, multi-organizational team and function administratively. The GWA PMT worked through the program management project (Program Management [PM] I – Program Coordination and Science Synthesis and Program Management [PM] II – Administration, SRP, PI Meeting Logistics, Outreach, and Community Involvement). The PM I project provided overall leadership to the program, including SRP engagement, science synthesis efforts, and coordination, and the PM II project provided fiscal support for non-Trustee organizations by applying EVOSTC funds passed through a grant from NOAA, funded the SRP and meetings, and provided program level outreach and community engagement. Additional methods used to support the GWA program are presented under Objectives 2-5, below.

Objective 2: Provide scientific data, data products, and outreach to management agencies and a wide variety of users.

The GWA PMT, through project 21120114-A&B (PM I and PM II), worked closely with the GWA projects and the separately funded EVOSTC Data Management program (Janzen et al. 2023) to meet Objective 2. Methods to meet this objective are fully described in the program management project final report (Lindeberg et al. 2023) and the individual monitoring project final reports and are summarized here. The PMT worked with the Data Management program team to develop a data management compliance plan that required monitoring projects to make GWA data available to the public through the Alaska Ocean Observing System's (AOOS's) GOA Data Portal within specified timeframes.

The Science Coordinator worked with project PIs to develop time series to submit to NOAA's GOA Ecosystem Status Report (ESR) annually. The report is submitted to the North Pacific Fishery Management Council for decision making related to commercial fisheries in the Gulf of Alaska.

The Program Lead worked with pelagic and environmental drivers PIs to develop graphic illustrations for these components (nearshore graphics were developed during the FY12-16 funding cycle).

PMT members presented about the GWA program to a variety of management agencies and other decision makers and distributed a quarterly newsletter of GWA activities.

PMT also maintained the GWA program website and worked with monitoring project PIs to present and discuss findings with the public, particularly in communities within the spill-affected area.

Objective 3: Develop science synthesis products to assist management actions, inform the public and guide monitoring priorities for the next 15 years.

The Science Coordinator led science synthesis efforts through the program management project (Lindeberg et al. 2023) and with the support of monitoring project PIs and the HRM program (Pegau 2023). The primary science synthesis effort included planning and coordination to prepare a science synthesis report required by the EVOSTC Invitation (EVOSTC 2015) and subsequent publication of report chapters in peer reviewed journals. See the program management project final report (Lindeberg et al. 2023) for more detailed methods.

Objective 4: Continue to build on collaborations between the GWA and HRM programs, as well as other Trustee program focus areas including the data management program, lingering oil, and potential cross-program publishing groups.

Collaboration with the HRM and Data Management programs occurred from the program management and project levels. Lingering oil projects funded by the EVOSTC were incorporated into either the GWA or HRM program and EVOSTC decided to use funding intended for cross-program publication groups for other purposes, so that part of Objective 4 is not discussed further.

GWA included HRM and Data Management program leads on correspondence with GWA team members, provided invitations to HRM and Data Management team members to attend and present at GWA quarterly meetings, facilitated data and field data collection sharing between GWA and HRM monitoring projects, and ensured compliance with data management data publication requirements. Additional methods for collaboration with the HRM and Data Management programs are presented under Objective 2 and in individual project final reports.

Objective 5: Leverage partnerships with outside agencies and groups to integrate data and expand capacity through collaborative efforts.

Throughout the five-year funding cycle, the GWA PMT and PIs worked with agencies, other funding entities, and scientists outside the program to leverage partnerships and collaborate. Methods to meet this objective were varied and are found in individual project reports.

RESULTS AND DISCUSSION

GWA program results are presented in detail in each of the project reports with a few selected items presented below by objective. Where appropriate, references to project final reports are provided. Most projects were affected to some degree by the global coronavirus pandemic that resulted in state and federal travel restrictions and mandates related to gatherings. Project teams developed innovative methods to continue safely collecting data to the extent possible and data loss was minimized. See individual reports for specifics on pandemic impacts and modifications.

Objective 1: Sustain and build upon existing time series in the EVOS-affected regions of the GOA.

Environmental Drivers monitoring component

Continuous Plankton Recorder

Six CPR transects were sampled each year (Ostle and Batten 2023). Fig. 3 shows the annual abundance of diatoms and small copepods. The results for 2019 suggest a similar situation to that of 2014-2016, where warm temperatures correspond to high numbers of small copepods and low numbers of diatoms, although the 2019 event is short lived, and conditions appear closer to baseline in the latter years.

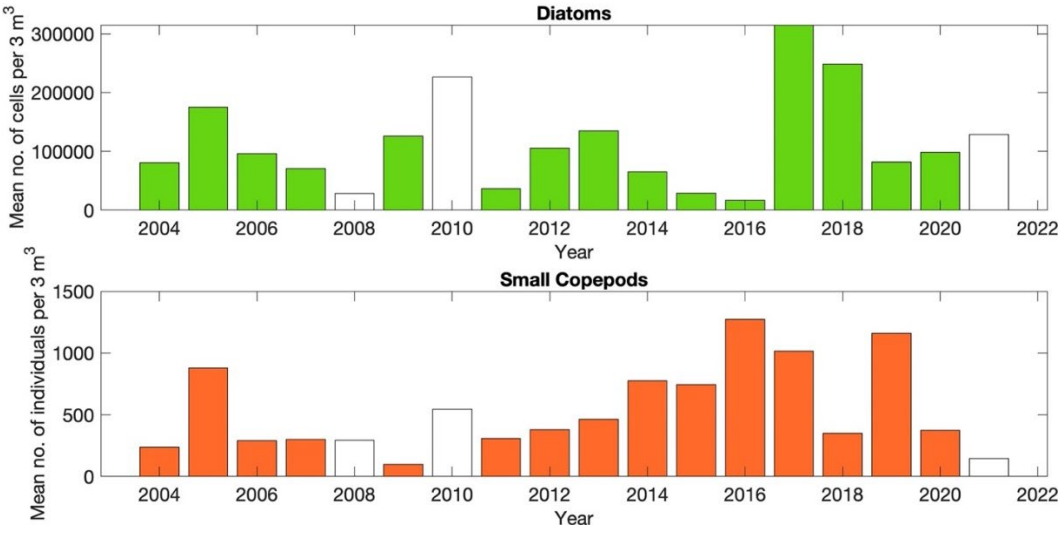

Figure 3. Mean annual abundance of diatoms (green bars) and small copepods (<2mm total length, orange bars) from shelf samples near Cook Inlet. Unfilled bars are years when sampled months <4 and so data are not as robust. Note: 2021 data are provisional.

Oceanographic conditions in Prince William Sound

Temperatures in central PWS have continued to be above average since late 2013 (Fig. 4), corresponding with the Pacific marine heatwave observed basin wide. Contemporary data showed a weak cooling trend into early 2018 to depths >50 m, and a brief period of negative anomalies, with anomalies again trending warmer than average in late 2018 and 2019. Weakly negative anomalies were observed again in 2021, and near-surface temperature anomalies were again high in early 2022.

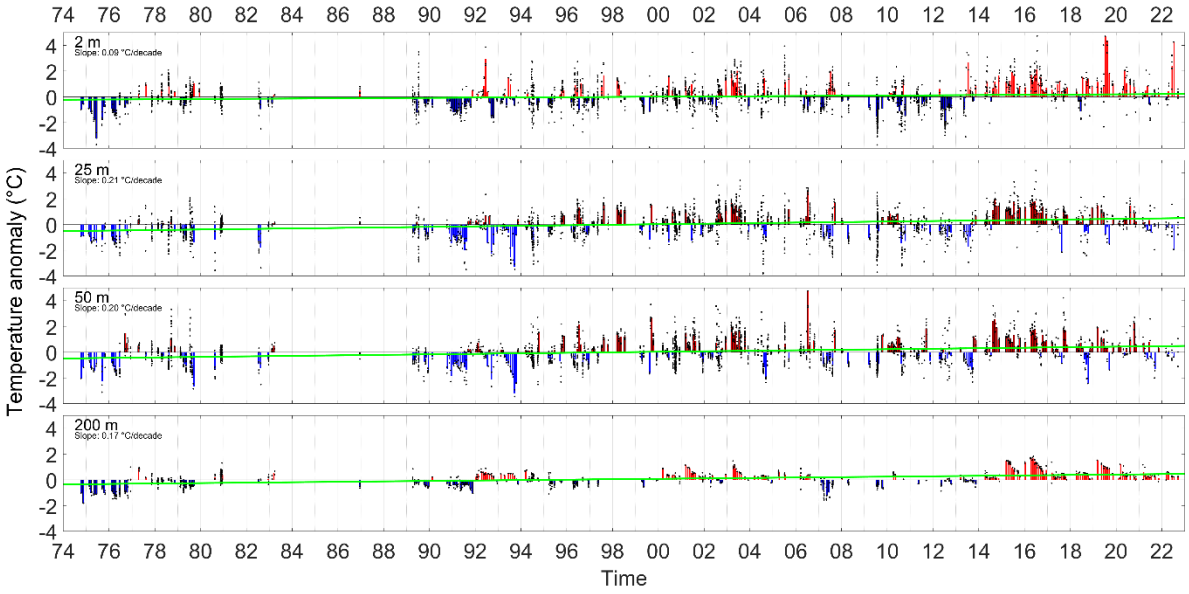

Figure 4. Temperature anomalies in central Prince William Sound. Anomalies were calculated with the method of Campbell (2018). Green lines indicate the long-term trend (slope reported on each figure) calculated by least-squares regression.

Abundance anomalies of all zooplankton species combined did not vary to a great degree over the entire 2009 – 2021 time series (Fig. 5, top panel; note that the y-axis scales vary among panels). Overall zooplankton abundance was well below average in 2021 and appears to have been primarily driven by a decline in cool water taxa (Fig. 5, middle panel). In addition to 2021, there were brief "stanzas" of lower-than-average abundances of cool water taxa in 2016 and 2019. Warm water taxa became more prevalent in the years following the Pacific marine heatwave (2014-2017: Fig. 5, bottom panel), and were also more common in late 2019 and late 2020.

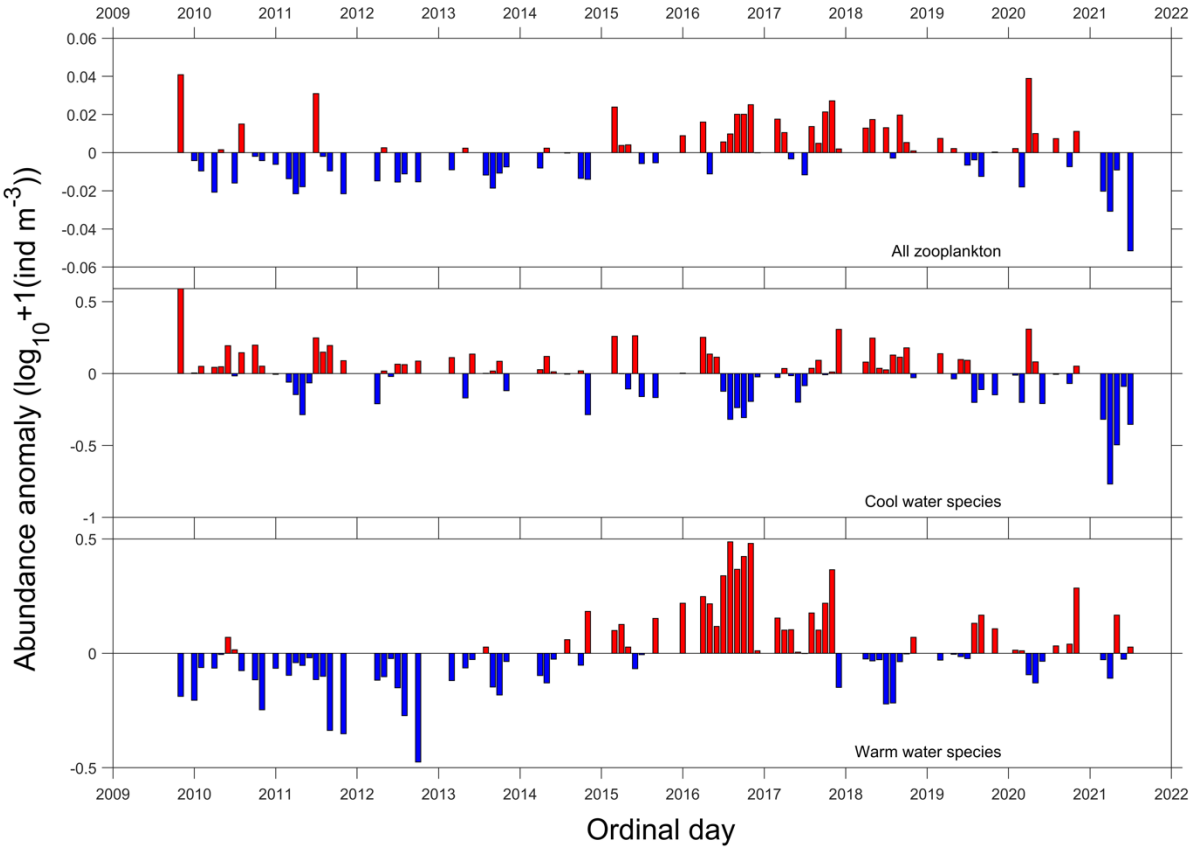

Figure 5. Zooplankton anomaly time series for all species (top panel), cool water species (middle panel), and warm water species (bottom panel). Cool water species are Neocalanus plumchrus, N. flemingeri, Acartia longiremis, Calanus marshallae, Oithona similis, *and* Pseudocalanus *sp. Warm water species are* Calanus pacificus, Clausocalanus, Corycaeus anglicus, Ctenocalanus vanus, Mesocalanus tenuicornis, *and* Paracalanus parvus.

GAK-1 monitoring
Project 21120114-I

Anomaly plots reveal multi-year periods of primarily warm or primarily cool anomalies (Fig. 6). Previously identified trends (e.g., Royer and Grosch 2006, Kelley 2015, Danielson et al. 2022) continue and show that the entire water column has a statistically significant record-length warming ($p < 0.01$) that is greater at the surface (0.22 °C decade^{-1}) than near the seafloor (0.16 °C decade^{-1}). Trends in salinity show record-length decline at the surface (-0.056 decade^{-1}) but increase near the seafloor (0.037 decade^{-1}). Analysis of the seasonality of the monthly anomalies and their trends reveals that they do not manifest equally year-round, with larger salinity anomalies prevalent in late summer and fall months and thermal anomalies largest in winter and spring.

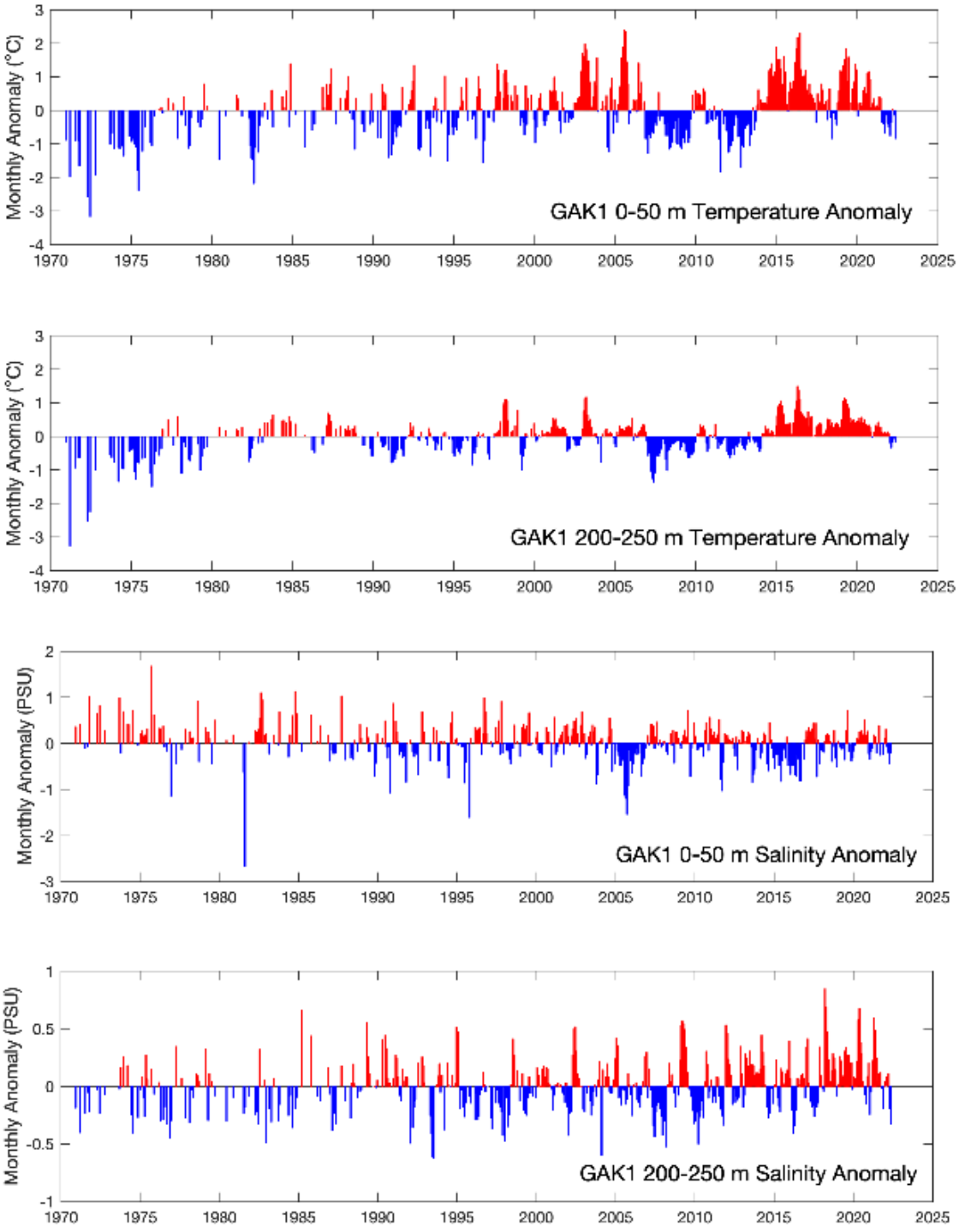

Figure 6. GAK-1 monthly anomalies of near surface (0-50 m) and near bottom (200-250 m) temperature and salinity over 1970-2022. Note change of scale amplitude for the two salinity plots.

Oceanographic conditions in Cook Inlet and Kachemak Bay

This project met the primary goals of maintaining and enhancing several time-series of oceanographic data from daily to monthly, seasonal, and annual time scales, comparable to GWA studies in PWS and complimentary to GWA environmental drivers sampling in the GOA, both of which are "upstream" regions in the oil spill affected area.

The 2017-2021 funding period was a transition from the 2014-2016 Pacific marine heatwave to average conditions in 2017-2018, followed by anomalous warming throughout much of 2019, and then greater seasonal variability in 2020 and 2021 (Fig. 7). Precipitation and glacial melt associated with warming increased freshwater flow in surface waters of Kachemak Bay and into the Alaska Stream resulted in increased inflow of freshwater in Cook Inlet and freshening of bottom water in Kachemak Bay (Fig. 7).

Phytoplankton species that produce saxitoxins causing paralytic shellfish poisoning (e.g., *Alexandrium* spp.) increased during warm heatwave years, then subsequently decreased, even during subsequent warm years like 2019 (Fig. 8). However, toxin levels in some higher trophic level fish species such as sand lance and herring were above limits safe for human consumption in 2019, indicating a need to further understand mechanisms of uptake and toxin accumulation in the food chain.

Zooplankton abundance and species composition did change during the marine heatwave. Warm water associated species appeared earlier in spring and remained later in fall during the heatwave years, likely allowing an overwintering population of warm water zooplankton in Lower Cook Inlet and Kachemak Bay. However, there was no clear response of lipid-rich calanoid copepods before, during, and after the heatwave.

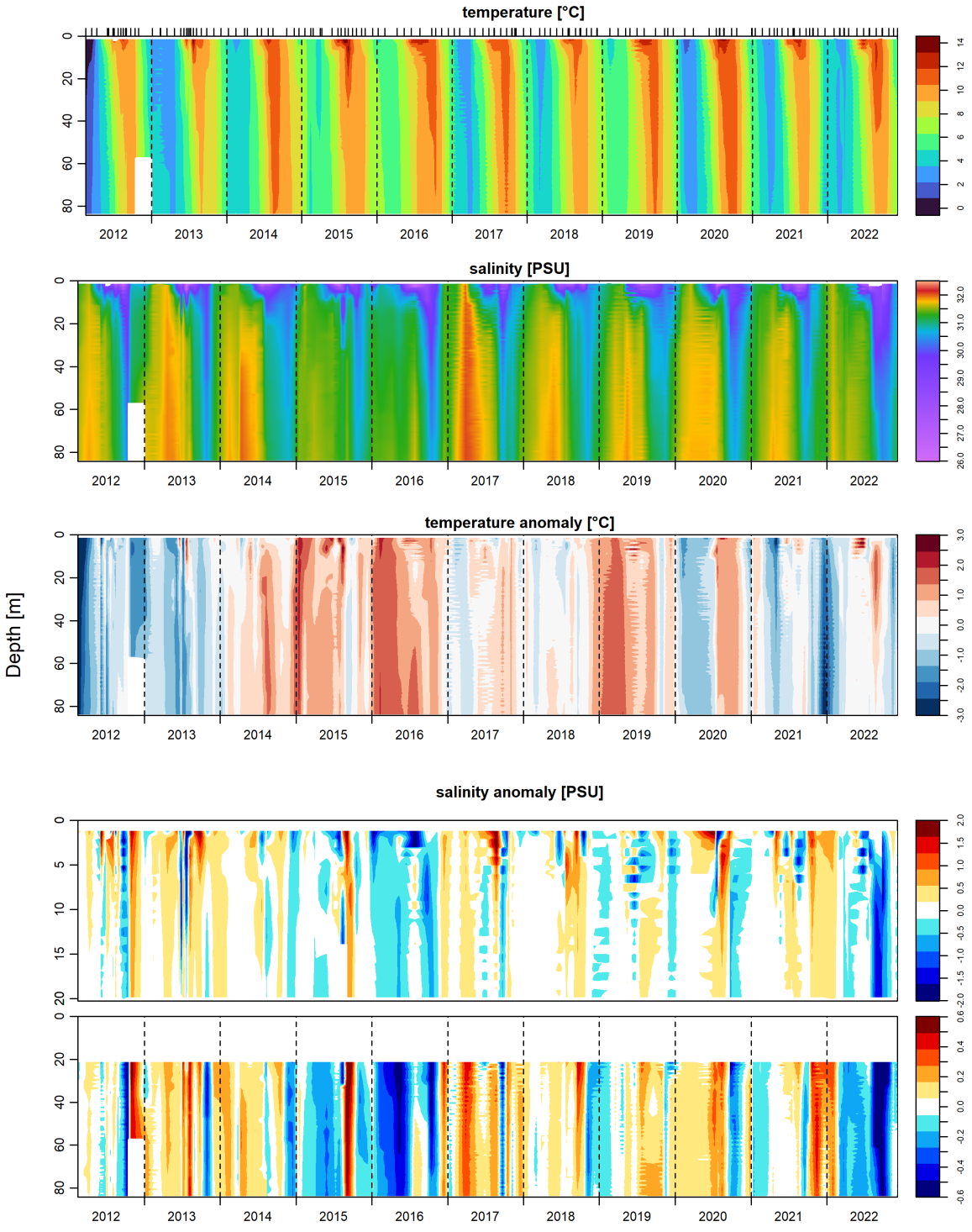

Figure 7. Temperature and salinity profile time series and anomalies center of Kachemak Bay location (Transect 9, station 6). For the salinity anomaly, the surface and deeper layers are shown separately, with different scales.

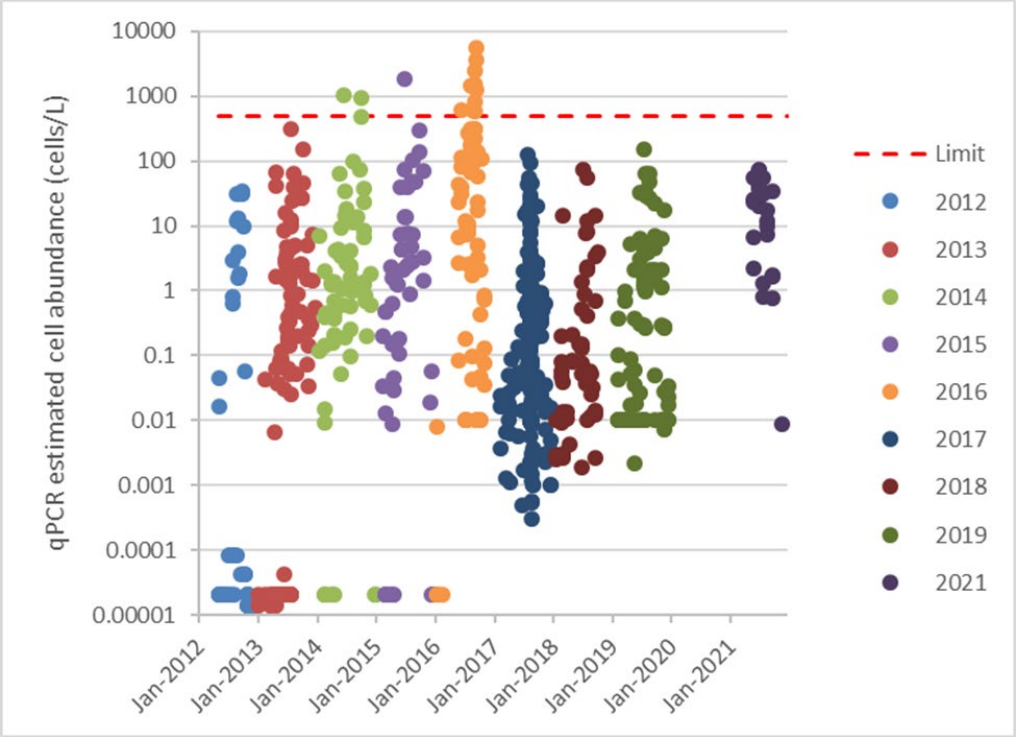

Figure 8. Alexandrium abundances from 2012-2021 (2020 samples were not analyzed). The y-axis is a logarithmic scale of cells per liter and the red dashed line indicates the 500 cells/L concentration which is the concentration at which paralytic shellfish toxins can accumulate in shellfish and pose risks to human health, as well as to marine species.

Seward Line

In spring, we observe a relatively narrow range (5.5 to 6.0 °C) of 0-100 m temperatures across continental shelf and Seward Line stations GAK-1 to GAK-13. In contrast, the mean temperature range of 0-100m depth in September exceeds two degrees (7.7 to 9.9 °C), with nearshore temperatures usually significantly warmer than offshore waters (Fig. 9). The sign of the temperature gradient changes over the intervening months: nearshore waters are typically cooler than offshore waters in spring but warmer than offshore waters in fall (Fig. 9). In all months, the coastal salinities are lower than salinities found offshore. In September, the cross-shelf salinity range more than doubles in magnitude, reflecting accumulation of freshwater in the coastal zone over the course of the summer. Warmest springs occurred in 1998, 2003, 2015-16, and 2019, and these generally correspond to warmer Septembers, although September 2014, 2017, and 2022 were also notably warm (Fig. 9).

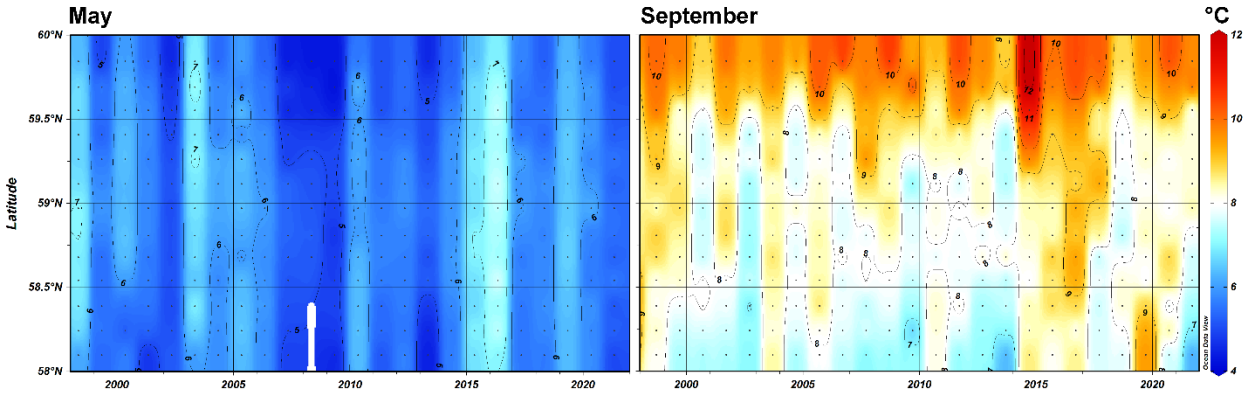

Figure 9. Average water temperatures in the upper 100 m along the Seward Line during May and September, 1998-2021.

The Pacific marine heatwave had relatively little impact on the abundance of the large copepods that dominate the spring copepod community. In contrast, years during which warm waters persist into September have a marked increase in warm-water California Current species that are less rich in lipids. The abundance of warm water calanoid copepod species (Fig. 10) during fall is highly correlated (r^2=0.51) to the Pacific Decadal Oscillation during prior months.

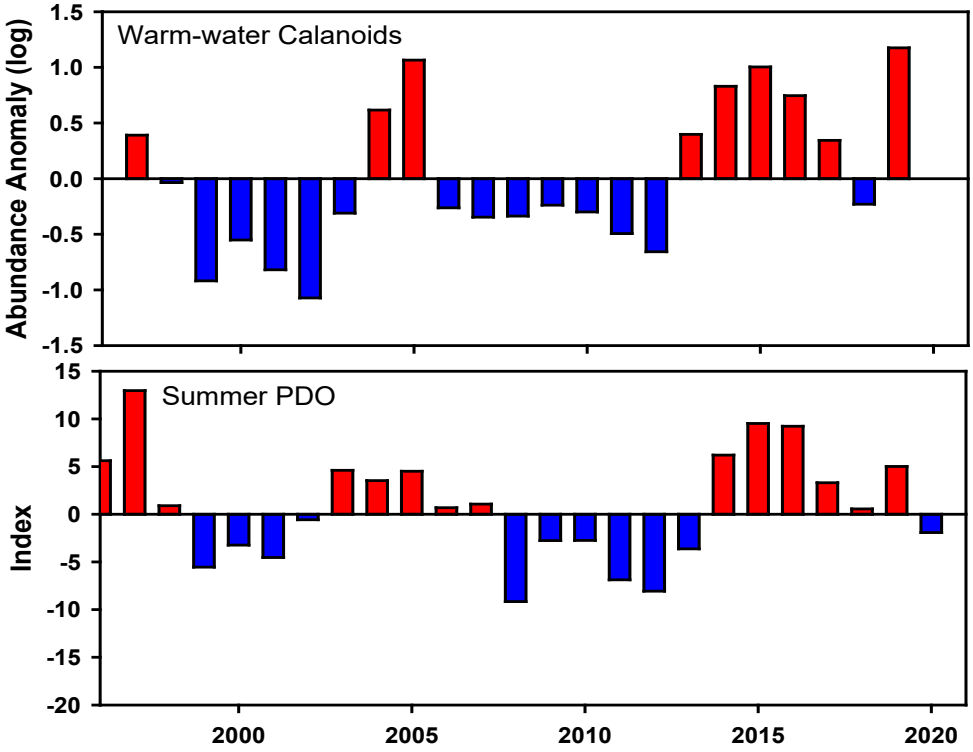

Figure 10. Abundance anomaly of warm-water calanoid copepods along the Seward Line compared to the Pacific Decadal Oscillation (PDO) for the preceding six months; both are highly correlated (r^2=0.51).

Pelagic Ecosystem monitoring component

Forage fish distribution and abundance

Acoustic fish and macrozooplankton indices reflect interannual variability in abundance by region based on surveys conducted in September of each year. Sand lance and capelin were encountered infrequently (Fig. 11). Juvenile herring biomass was greatest in Montague Strait during 2018, though they were encountered more commonly in Port Gravina. Macrozooplankton indices were relatively low in years sampled between 2017 and 2021 but increased in all three subregions during 2022 (Fig. 12).

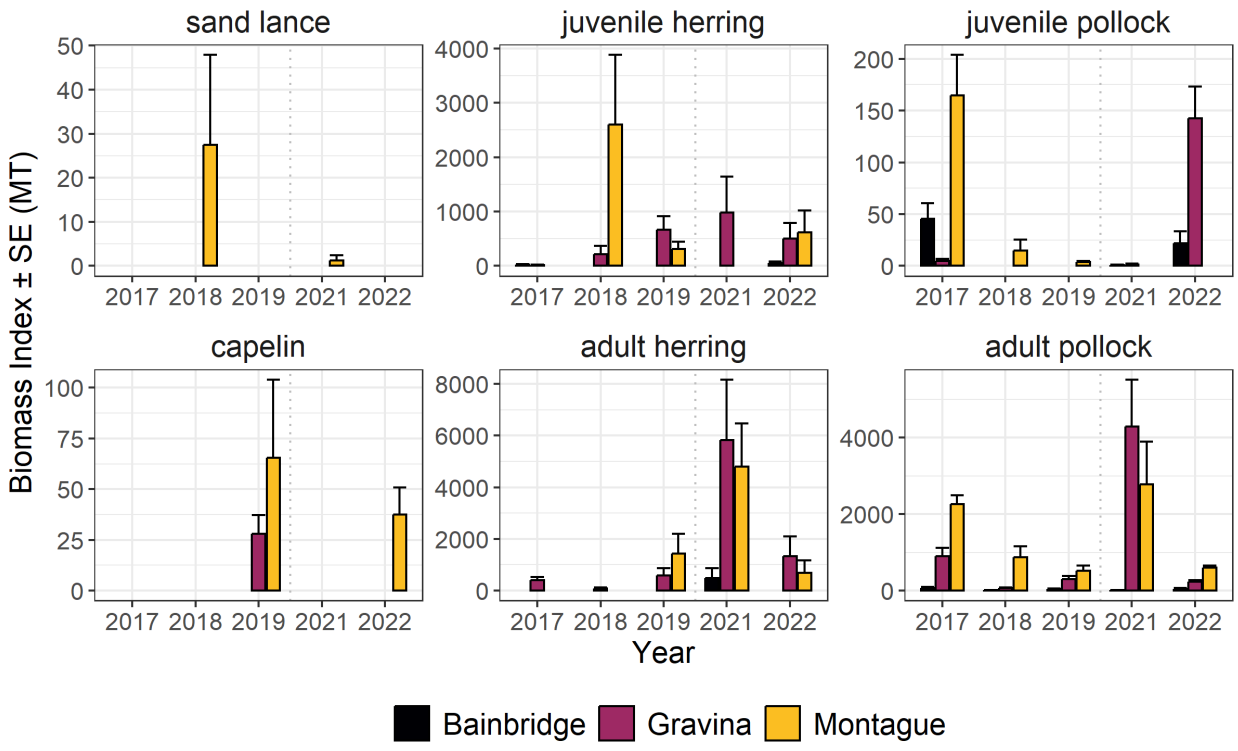

Figure 11. Acoustic indices of forage fish biomass by region and year in Prince William Sound, Alaska during September. No sampling was conducted in 2020 (dashed line).

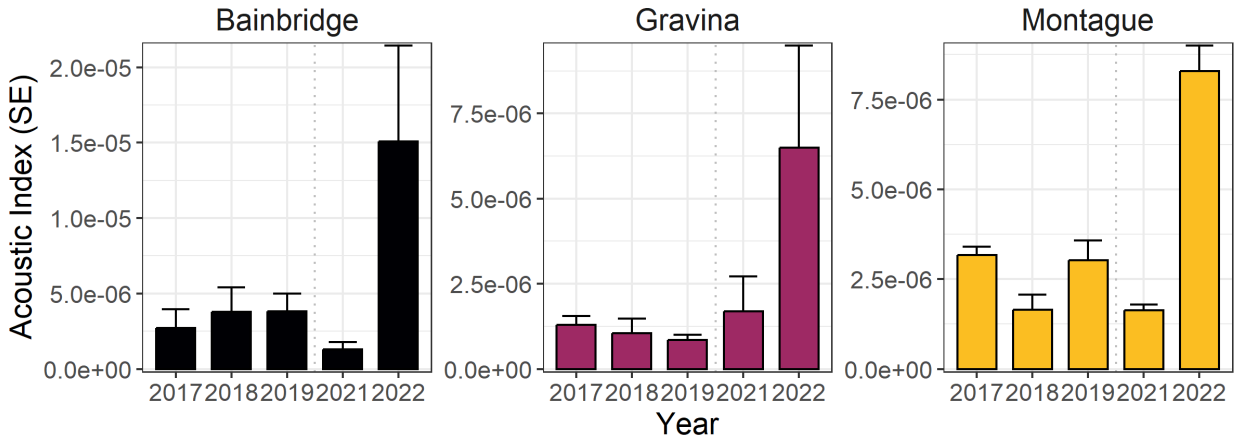

Figure 12. Acoustic indices of macrozooplankton abundance (area backscattering coefficient [ABC] m^2 m^{-2}) by region and year in Prince William Sound during September. No sampling was conducted in 2020 (dashed line).

Long-term time series of spring (pre-chick-rearing) and summer (chick-rearing) diets of seabirds on Middleton Island showed marked changes during and after the PMH starting in 2014

(Fig. 13). Primary changes include an increase in consumption of invertebrates in spring (March-April), with consumption of herring increasing in May through summer (June-August), and a major decline in capelin with only a moderate increase in sand lance.

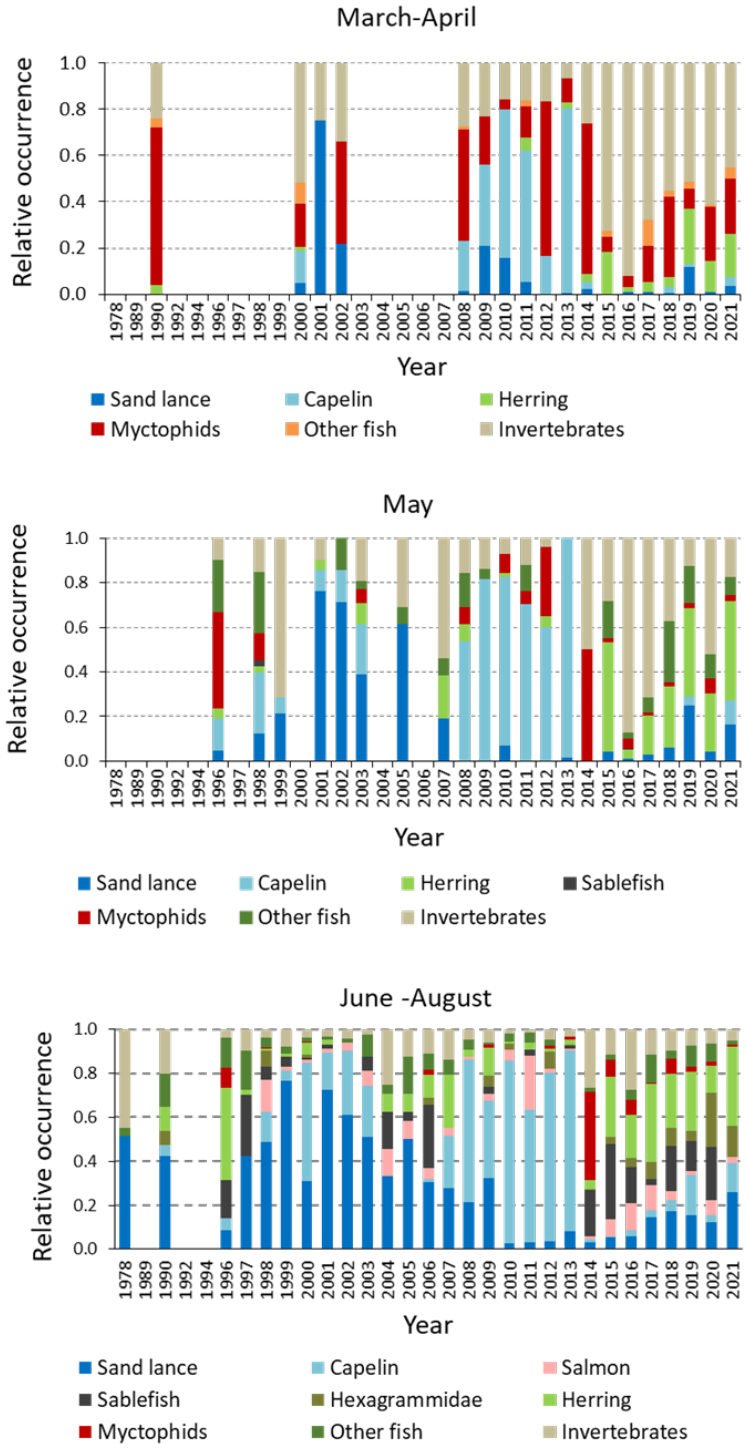

Figure 13. Interannual variation in kittiwake diet composition on Middleton Island, 1978-2021.

Winter habitat use and distribution of seabirds in Prince William Sound

We identified seasonal patterns in all (11) focal species groups when characterizing marine bird distribution over 15 nonbreeding seasons (2007/08 – 2021/22). Our results emphasize the importance of PWS as a refuge from the harsher conditions of the GOA. While wintering in the Sound, marine birds were more likely to be distributed in areas that were closer to shore, shallower, and protected from wave exposure (Fig. 14). Finally, our results underscore the complexity of predator-prey relationships during the nonbreeding season. Whereas only 20% of fish schools in surveyed bays were associated with birds, flocks were twice as likely to be observed within 150 m of a fish school. When examining upper-trophic level foraging dynamics, we observed humpback whales using forage flocks of seabirds as cues to locate scattered prey resources when whale, seabird, and forage fish abundances were suppressed following a heatwave event.

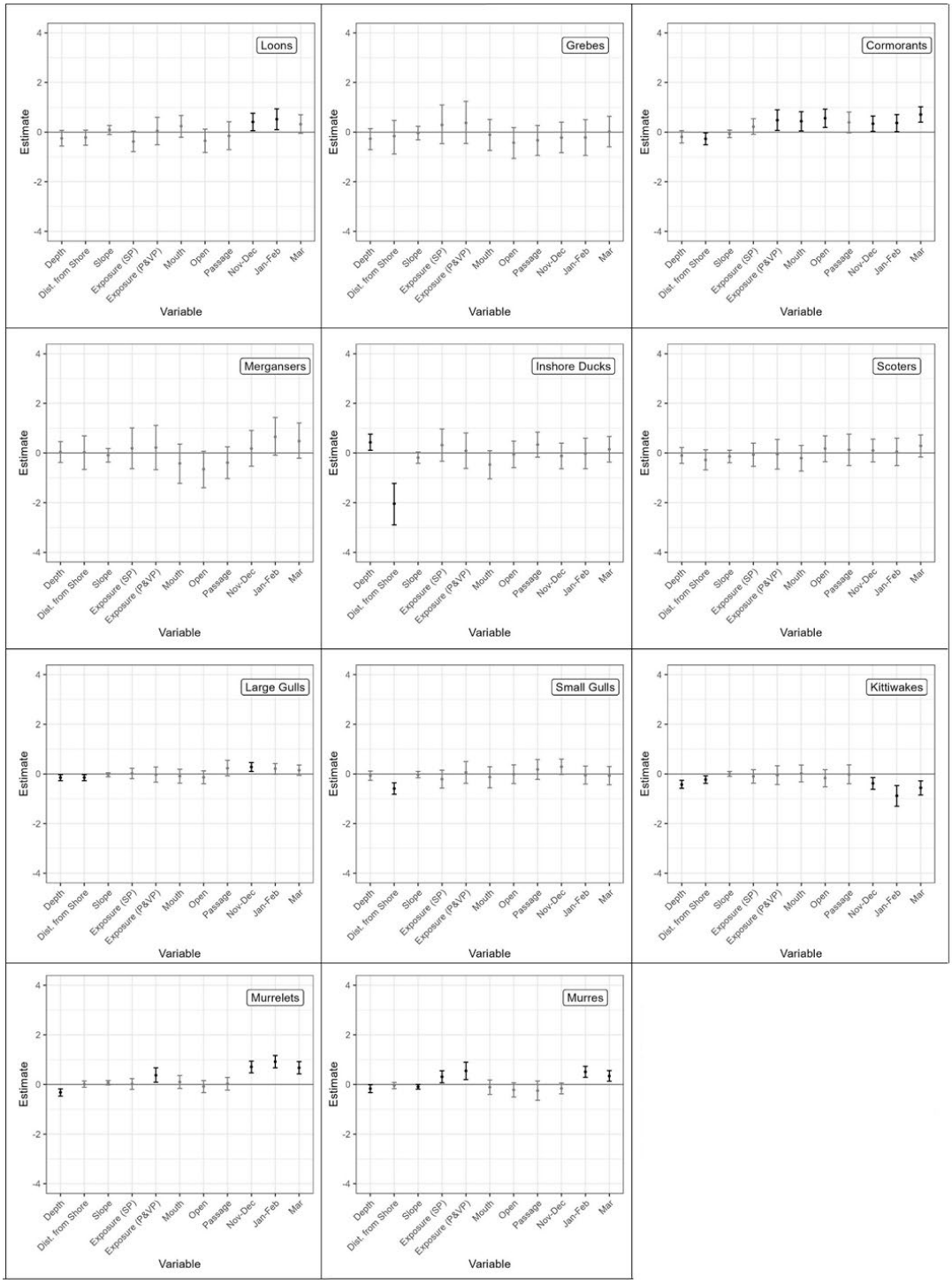

Figure 14. Estimates and 95% confidence intervals for the coefficients of the variables explaining marine bird distributions in Prince William Sound, Alaska, during nonbreeding seasons 2007/08-2021/22. Bold variables are those whose confidence intervals do not overlap zero. Estimates are on the log odds scale.

Prince William Sound and Gulf of Alaska marine bird population trends

Since PWS surveys were conducted during the even years, only two surveys were to be conducted during the 2017-2021 funding cycle (Kaler et al. 2023). However, due to the global coronavirus pandemic, the 2020 survey was cancelled. With the pandemic continuing in 2021 and the challenging logistics of this multi-vessel survey, it was decided to conduct the next survey in 2022. This strategy kept the alternate year survey on the same even year cycle and simplifies statistical modeling and assessment of trends.

While abundance of the majority of species are stable or increasing, five taxa of piscivorous species are still declining, including mergansers, murrelets, pigeon guillemots, and terns. (Fig. 15). Two of these declining species are still listed as injured by the EVOSTC (murrelets and pigeon guillemot). Species that did increase were primarily offshore species that appeared to move inshore into PWS.

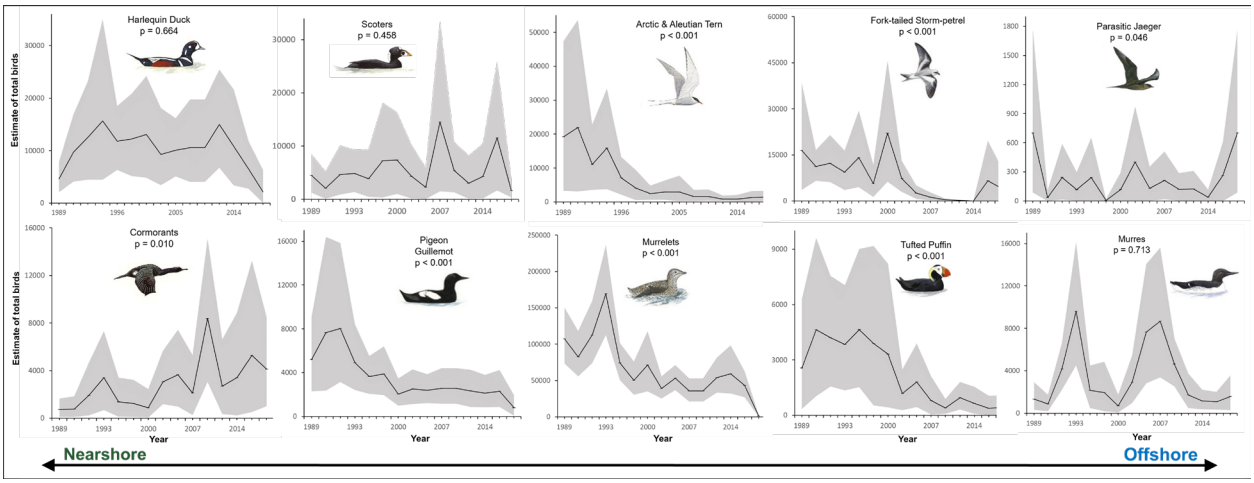

Figure 15. Trends in abundance of selected marine birds from summer surveys in Prince William Sound.

Marine bird surveys conducted along the Seward and Northern Gulf of Alaska Long-Term Ecological Research oceanographic sampling lines (Fig. 16) identified contrasting responses in annual densities to temperature for different marine bird groups. Three out of four typically offshore and more mobile species were positively associated with warmer upper-ocean temperatures. In contrast, during and after the marine heatwaves, piscivorous species including murres, kittiwakes, and gulls became less abundant on the shelf and concentrated near the coast, concurrent with reproductive failures and die-off events.

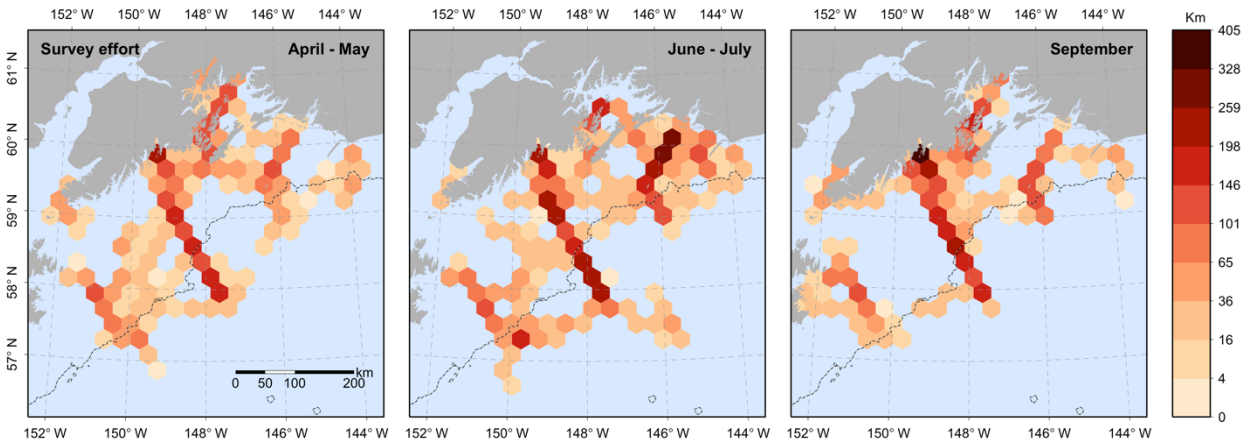

Figure 16. Seabird survey effort (linear km) during 2017–2021 Seward Line and Northern Gulf of Alaska Long-Term Ecological Research cruises, summarized within 30-km hexagonal grid cells.

Long-term killer whale monitoring

Two groups of killer whales are of strategic interest because they are known to have been directly injured by EVOS (Matkin et al. 2008): the AT1 population of transients and the AB pod of residents. After declining from 26 to 16 whales following the oil spill, AB pod had been slowly recovering to a post-spill high of 22 whales in 2015. However, AB pod declined in this reporting period from 22 whales in 2015 to just 14 whales in 2017, increasing to 16 in 2021. This latest decline came at the end of the PMH during 2014-2016 that has had acute and prolonged impacts on the Gulf of Alaska ecosystem and apparently erased 30 years of post-spill recovery of AB pod (Fig. 17). The AT1 population has remained constant at seven individuals, with no mortality or recruitment (Fig. 17). This remains below their pre-spill high of 22 individuals. Further recruitment is not expected because the remaining females are beyond known reproductive age for killer whales.

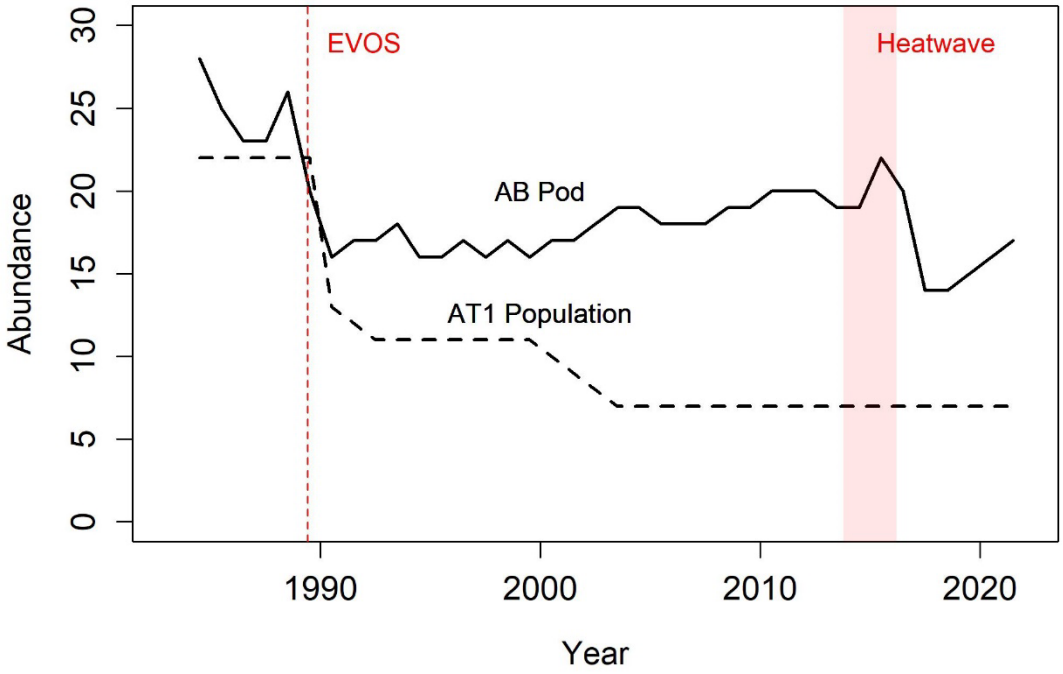

Figure 17. Number of killer whales (Abundance) in the AB pod and AT1 population from 1984 to 2021. The timing of the Exxon Valdez Oil Spill (EVOS) and the Gulf of Alaska marine heatwave are indicated in red.

Chum (*Oncorhynchus keta*) and Chinook (*O. tshawytscha*) salmon were the dominant species identified from fecal samples of killer whales. Pacific halibut (*Hippoglossus stenolepis*), arrowtooth flounder (*Atheresthes stomias*), coho salmon (*O. kisutch*), and sablefish (*Anoplopoma fimbria*) were also present, in addition to lower occurrences of sockeye salmon (*O. nerka*). In the scale/flesh dataset, only chum, Chinook, coho, and sockeye occurred at these levels.

Humpback Whale predation on herring

Humpback whale numbers have failed to rebound in PWS following a decline associated with the 2014-2016 Pacific marine heatwave in the GOA. Encounter rates for humpback whales during the fall IPP survey were lower than the preceding years (Fig. 18). The reduction of humpback whales is possibly related to a decline in the biomass of herring in PWS or lingering population effects from the heatwave. We identified 403 individual whales that used the waters of PWS from November of 2006 through September of 2021. Because it is unlikely that we photographed all of the whales within PWS, this number should be considered a minimum estimate of abundance for the time period. The total number of whales that have inhabited PWS during this time period as estimated by the Jolly-Seber-Cormack mark-recapture model is 428, excluding calves. The proportion of herring biomass consumed by humpback whales decreased

during this study period (2017-2021) relative to the pre-heatwave period (2007-2014) when using whale abundance estimated from the Jolly-Seber-Cormack open population model.

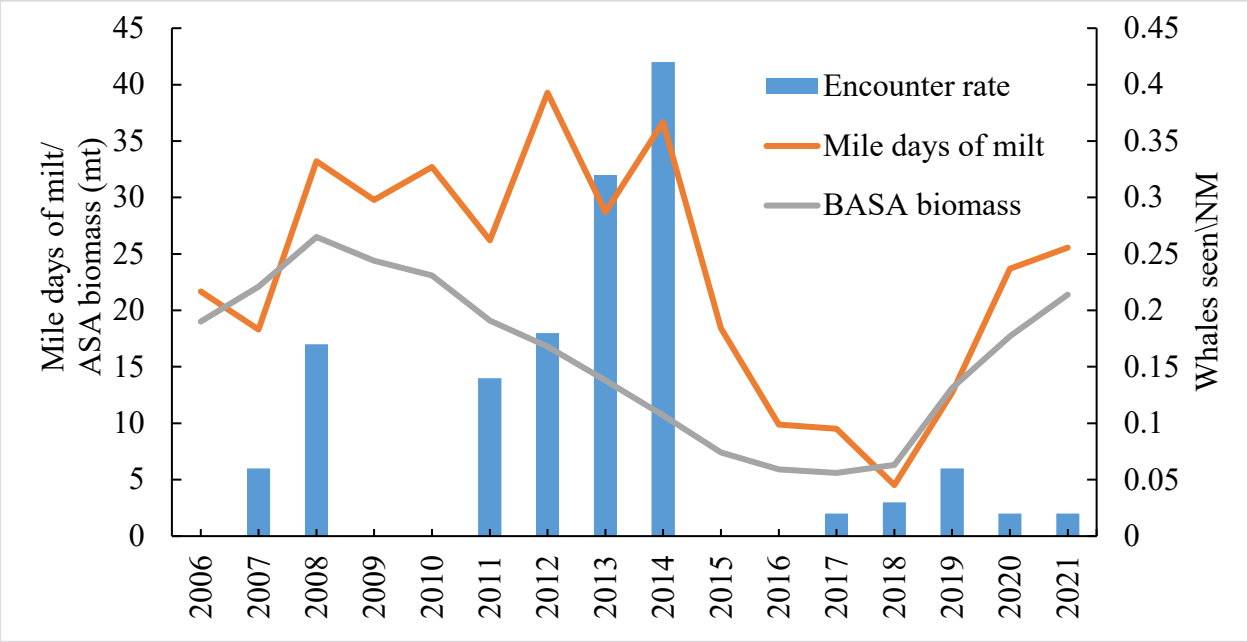

Figure 18. The mile-days of milt (cumulative miles of herring spawn) as reported by Alaska Department of Fish and Game surveys (Haught and Moffitt) and the Herring Research and Monitoring program, herring biomass from the Bayesian age structured assessment (BASA) model and humpback whale encounter rates from fall surveys in Prince William Sound, Alaska.

Nearshore Ecosystem monitoring component

Nearshore systems in the Gulf of Alaska

Intertidal water temperature in all four nearshore component monitoring regions showed a warming trend beginning in 2014 and persisting across all regions through 2016; warming continued into 2017 in WPWS and KEFJ (Fig. 19). These results confirmed that the 2014-2016 marine heatwave in the GOA affected intertidal zones. While temperatures had appeared to cool and return to normal across all regions in late 2017 and 2018, 2019 indicated warmer than average water temperatures in the intertidal zone across all four study regions and a cooling during the early part of 2020, particularly in the western blocks of KBAY and KATM. Temperatures appeared to return to the long-term average across all regions early in 2021, followed by cooling across all regions into the summer months of 2021.

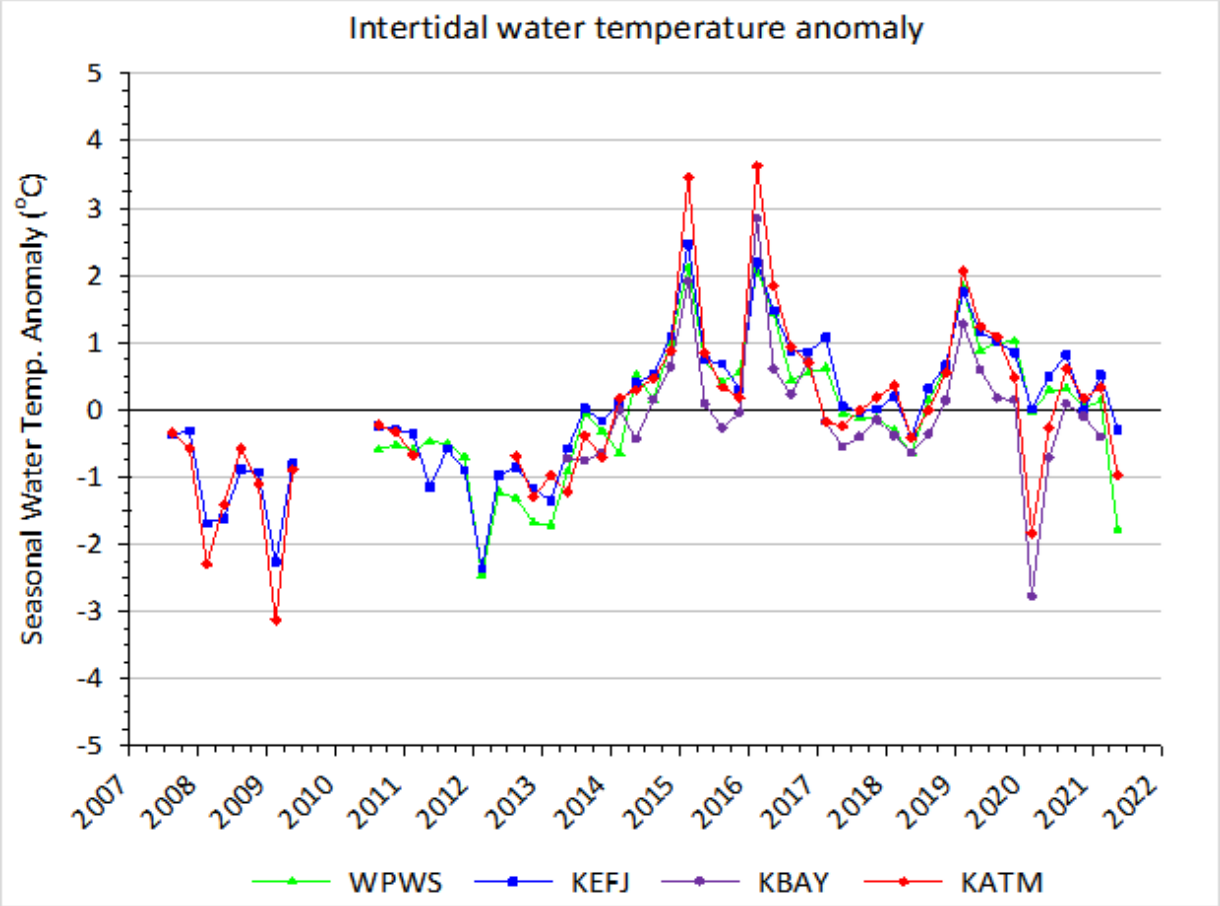

Figure 19. Seasonal intertidal water temperature anomalies at the 0.5 m tide level across western Prince William Sound (WPWS; 2011-2021), Kenai Fjords National Park (KEFJ; 2008-2021), Kachemak Bay (KBAY; 2013-2021), and Katmai National Park and Preserve (KATM; 2006-2021). Long tick marks indicate the start of the calendar year (January) while short tick marks are quarterly divisions within the year (April, July, October).

We examined rocky intertidal community structure at 21 sites across our four regions, spanning 1,200 km of coastline. Sites were monitored annually at mid and low tidal strata. In years 2012-2014, before the PMH, community structure differed among regions. During and after the heatwave (2015-2019), we found that macroalgal foundation species declined across the study regions. The GOA-wide shift from a macroalgal-dominated rocky intertidal to a filter-feeder dominated state concurrent with the changing environmental conditions associated with a marine heatwave event suggests the heatwave had Gulf-wide impacts to the structure of rocky intertidal communities. Similarities in community structure increased across regions, leading to a greater homogenization of these communities. This was due to declines in macroalgal cover, driven mostly by a decline in rockweed (*Fucus distichus*) and fleshy red algae in 2015, followed by an increase in barnacle cover in 2016, and an increase in mussel cover in 2017 (Figs. 20 and 21).

Strong, large-scale oceanographic events, like the PMH, may override local drivers to similarly influence patterns of intertidal community structure at broader scales (Weitzman et al. 2021).

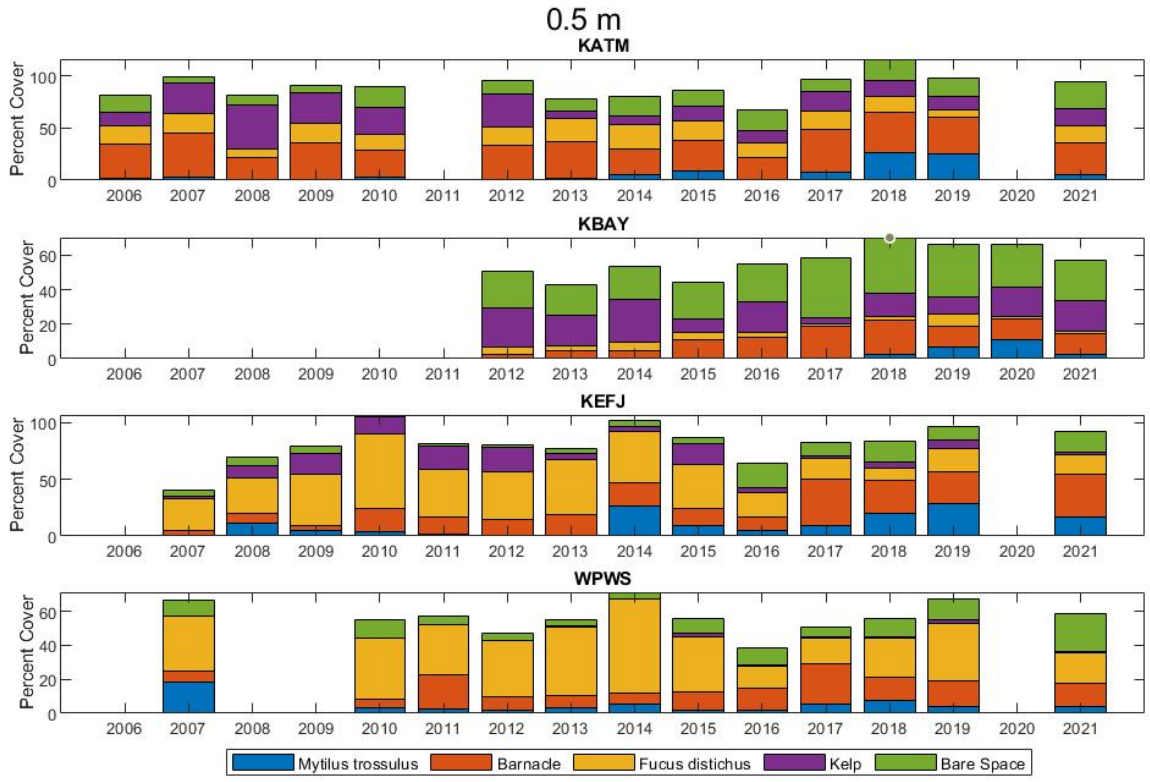

Figure 20. Percent cover of Mytilus trossulus, barnacles, Fucus distichus, kelps, and bare substrate at the 0.5 m tidal elevation across the four Gulf Watch Alaska regions: Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), Kenai Fjords National Park (KEFJ), and western Prince William Sound (WPWS), 2006-2021.

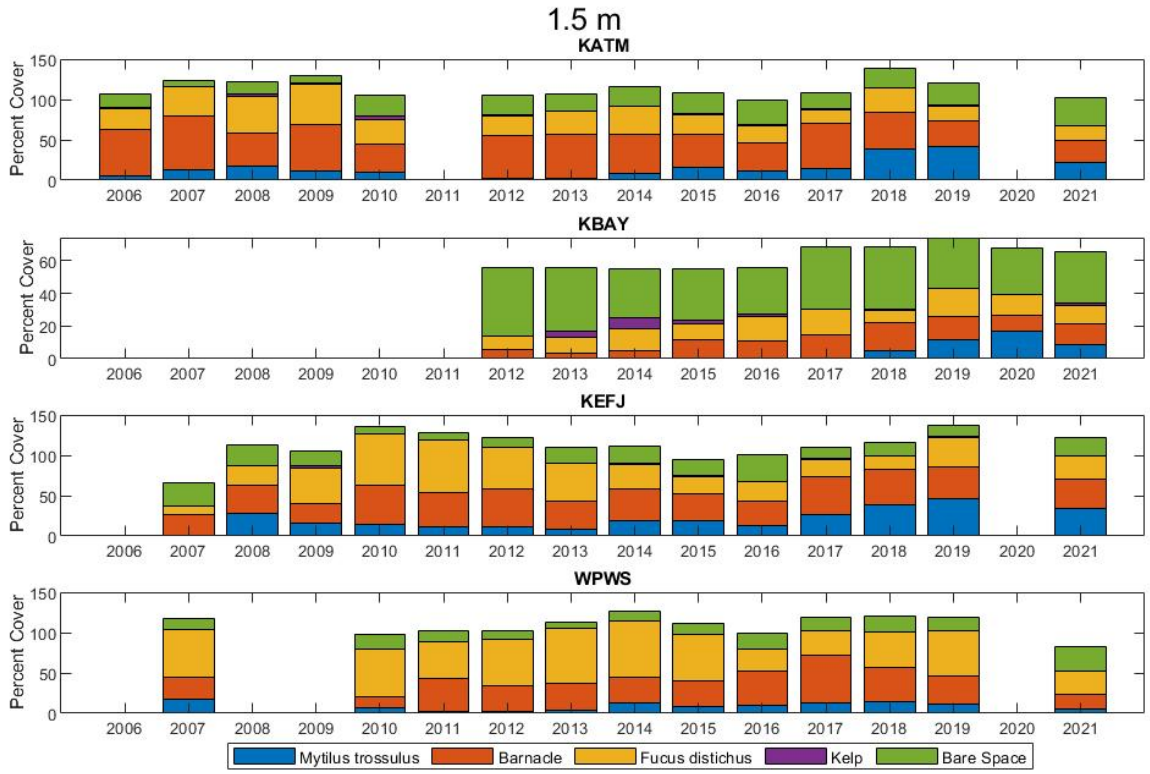

Figure 21. Percent cover of Mytilus trossulus, barnacles, Fucus distichus, kelps, and bare substrate at the 1.5 m tidal elevation across the four Gulf Watch Alaska regions: Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), Kenai Fjords National Park (KEFJ), and western Prince William Sound (WPWS), 2006-2021.

In general, bird abundance was similar between summer and winter within regions, but community composition was different between seasons with higher species richness at KEFJ in the summer. Winter coastal marine communities were characterized by a marked increase in benthic foragers and highlights the importance of nearshore coastal resources to sea ducks that primarily breed in the interior of Alaska but migrate to the coast in winter. Summer marine coastal bird communities were generally found to consist of colony nesting seabirds that eat large quantities of forage fish. In general, these bird species were present and breeding on colonies in the summer and absent in the winter. We found variation in trends in density of some bird species at the regional scale (Fig. 22), which suggests that drivers of abundance of marine birds are not coherent across the GOA. For other species, however, the lack of variation in trends in density across regions may indicate Gulf-wide drivers of abundance.

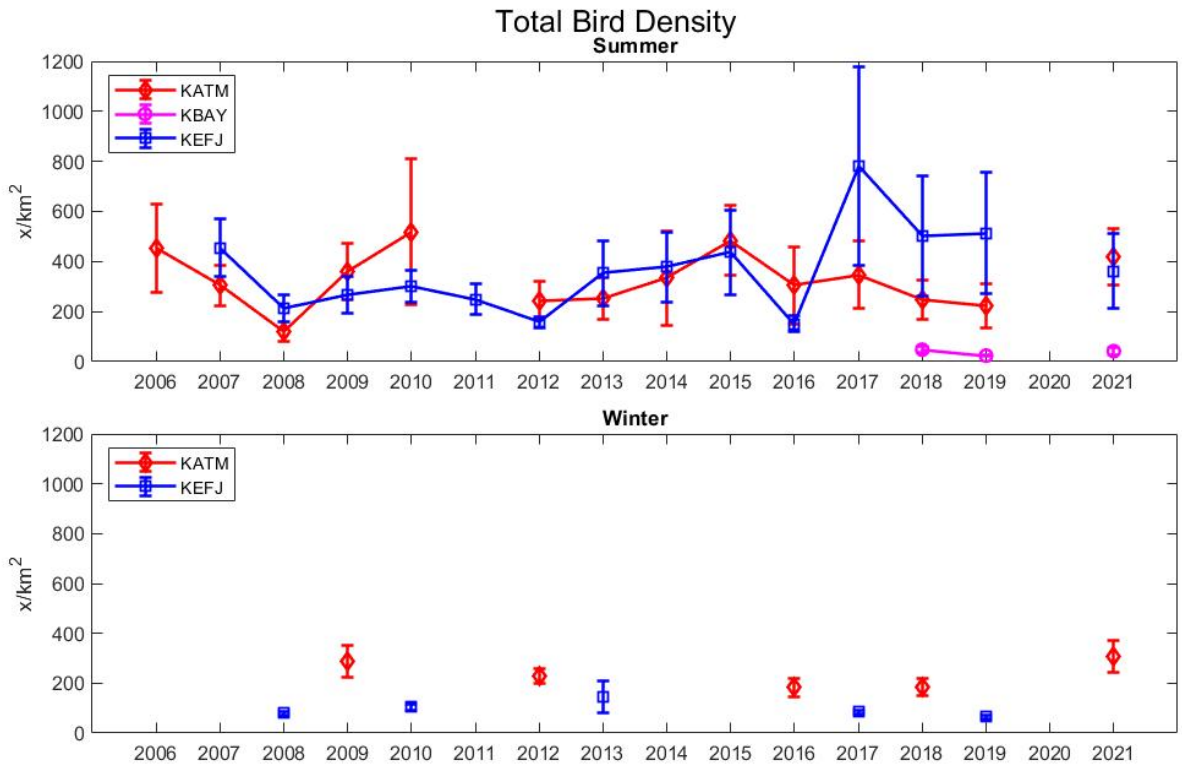

Figure 22. Overall bird species density estimates in summer (top) in Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), and Kenai Fjords National Park (KEFJ) and winter (bottom) in KATM and KEFJ. Error bars indicate ±1SE.

Sea otter *(Enhydra lutris)* abundance has been stable in KEFJ since 2006 and stable in KATM in recent years after achieving carrying capacity following re-occupation (Coletti et al. 2016). The sea otter population in KBAY also appears to have been stable since 2012, after a rapid increase in abundance since the early 2000s (Garlich-Miller et al. 2018). Survey data from WPWS show increasing trends through 2011, resulting from recovery from the EVOS, and generally stable numbers since (Esslinger et al. 2021) (Fig. 23).

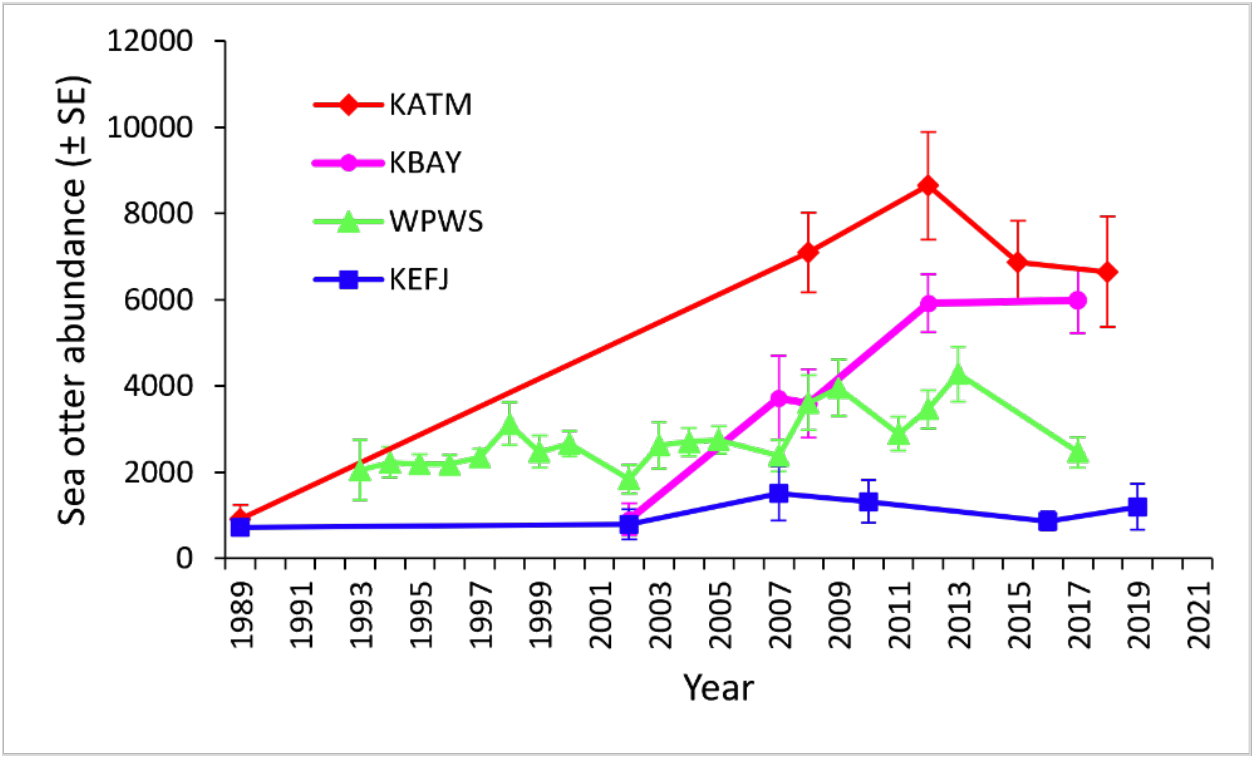

Figure 23. Sea otter abundance estimates across all four Gulf Watch Alaska regions: Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), Kenai Fjords National Park (KEFJ), and western Prince William Sound (WPWS). Error bars indicate ±1SE.

Sea otter responses to changing ocean conditions associated with the Pacific marine heatwave may have resulted in shifts in diet but not in energy intake rates (EIR) (Fig. 24). Across the sea otter's range, numerous studies have documented that energy intake rates around 4-6 kcal/min are indicative of populations that are near a food-dictated carrying capacity. Across all four nearshore component study regions, EIR have stabilized at levels that suggest sea otters are at or near carrying capacity. It is noteworthy that, despite EIR evidence of populations near carrying capacity in all regions, abundance and density estimates of sea otters differ widely among regions. We interpret this as a consequence of differing habitat quality, likely resulting from differing bathymetry and substrate, and thus prey availability, across our different study regions (Coletti et al. 2016).

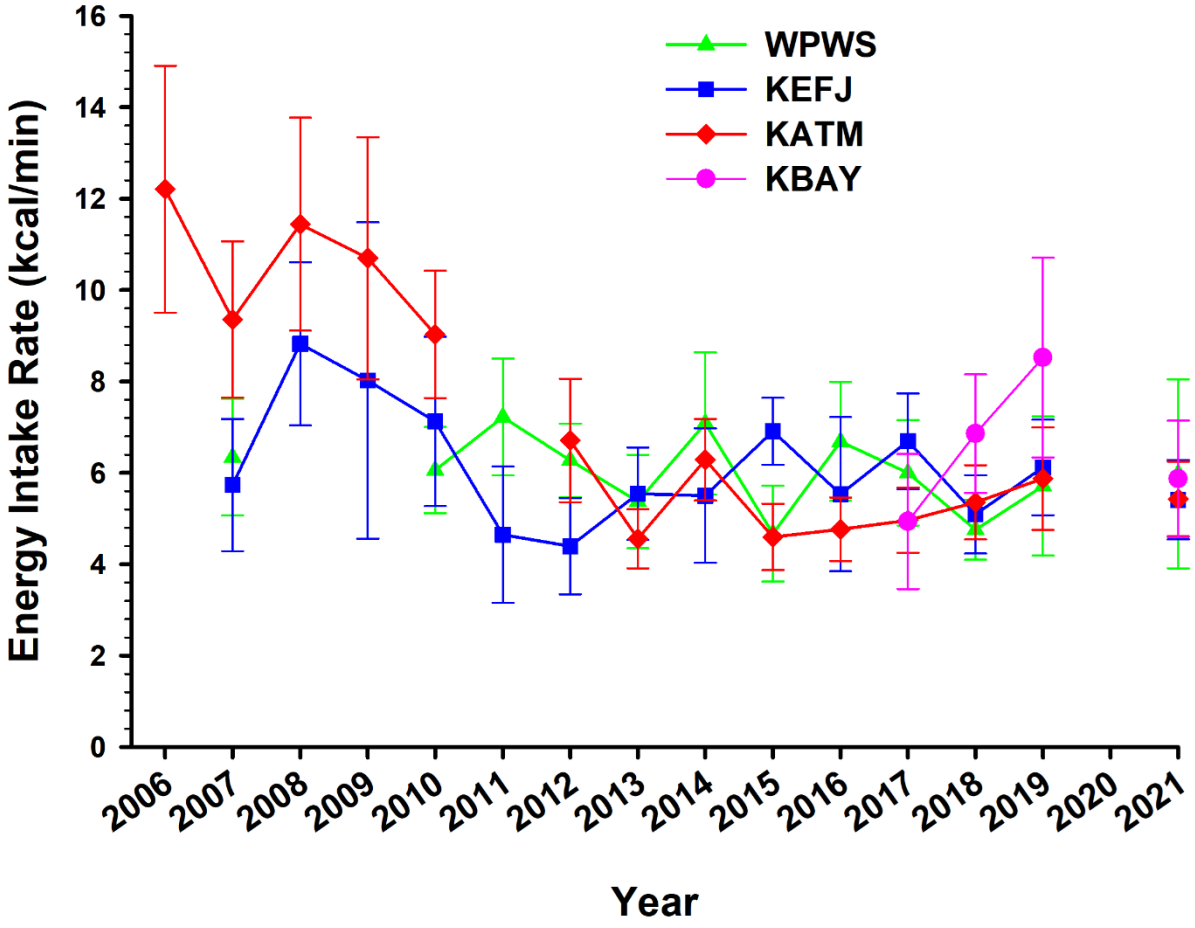

Figure 24. Sea otter energy intake rates across all four Gulf Watch Alaska regions: Katmai National Park and Preserve (KATM), Kachemak Bay (KBAY), Kenai Fjords National Park (KEFJ), and western Prince William Sound (WPWS). Error bars indicate ±1SE.

Lingering Oil monitoring component

Tracking oil levels and weathering

Small patches of *Exxon Valdez* oil have persisted on beaches contaminated in 1989. In 2021, beaches were assessed to update the EVOSTC on persistence of this oil. Surveys followed a random stratified design aimed at measuring the probability of encountering oil, from which we calculated the oiled area and the retention rate since 2015. We found oil on each of the beaches, but only one may have less oil than previously observed (Fig. 25). There has been a decreasing trend in encounter probability at one site, and the estimated oiled area is significantly reduced. However, the decreasing trend was not different from zero. Oiled areas were reduced on all beaches, but no other evidence suggested that oil contamination had decreased, therefore some

changes may simply be an effect of survey design. We conclude that subsurface oiling conditions are still much like they were when the oil made landfall. Previous work has shown that the oil has not weathered since making landfall. We conclude that after 32 years, remaining oil is still sequestered and therefore has limited bioavailability.

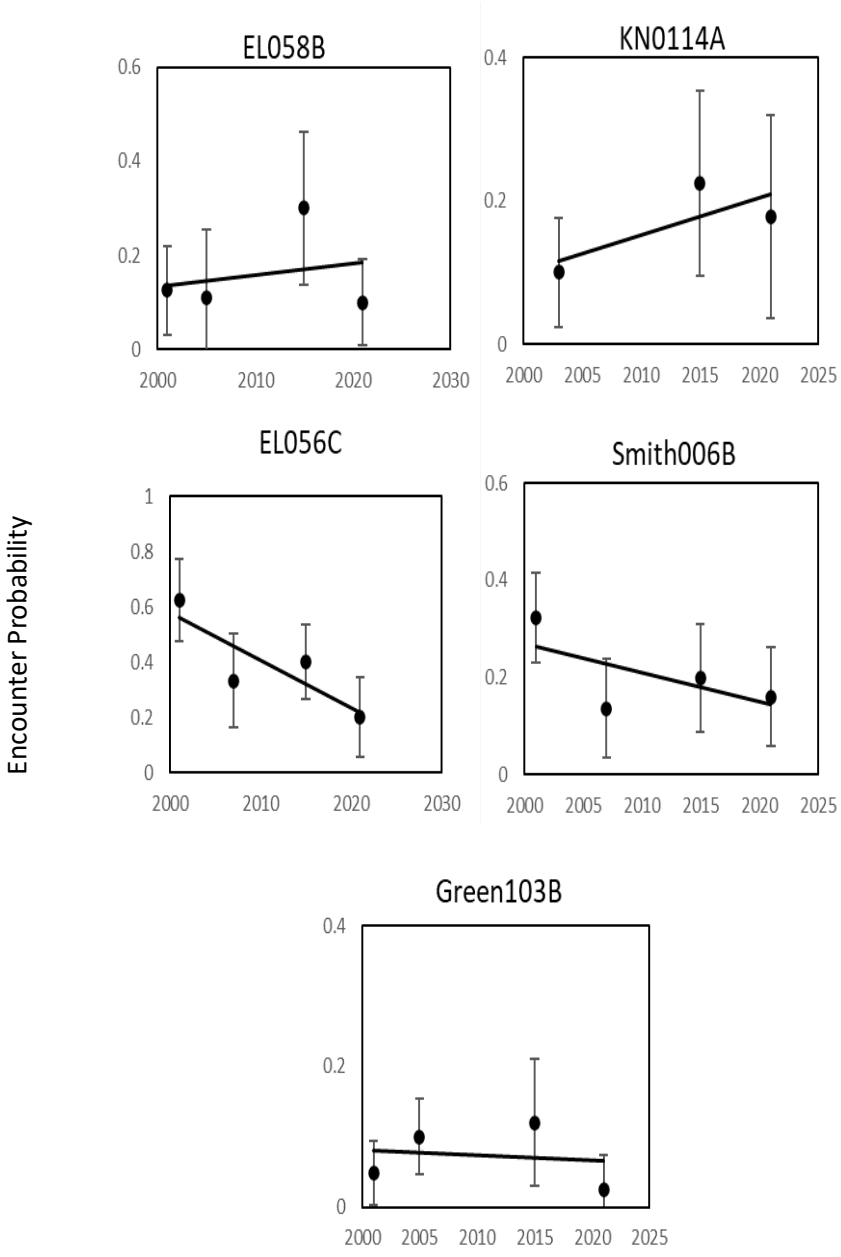

Figure 25. Temporal change in encounter probabilities for beach segments surveyed in 2021. Symbols depict 95% confidence intervals and lines were derived from linear regressions.

Integrated program management and administration

Program Management I and Program Management II

The PMT provided oversight for 12 projects, more than 40 PIs and team members (Fig. 26), five Science Review Panel members, and ensured efficiency in operations (e.g., grant administration and subaward management), troubleshooting (e.g., adapting to the coronavirus pandemic), reporting (e.g., review and formatting), and product delivery (e.g., science synthesis and outreach).

Figure 26. Gulf Watch Alaska group photos from fall Principal Investigators meetings in Homer at the Alaska Islands and Ocean Visitor Center in 2019 (top) and virtually in 2020 (bottom).

During this second 5-year reporting period, GWA greatly expanded its integrated products. Science synthesis efforts increased its NOAA Ecosystem Status Report contributions by 3-fold to 21 annually. These are GWA's signature time series to indicate the annual state of the GOA

physical and biological environment. We produced four high-level publications (one led by the PMT) integrating across GWA, HRM, and many external collaborators to describe how the GOA and EVOS injured resources responded to the largest marine heatwave observed in modern times. In 2021, seven years after the first heatwave, some EVOS injured resources are just now returning to pre-heatwave levels (herring), while others have possibly suffered even greater setbacks where almost 30-years of post-spill recovery was lost (killer whales). We led two special issue journals for peer-reviewed publications of GWA authors and collaborators: one that was initiated during the first 5-year period and one originating from this funding cycle. Program management also gave over 20 presentations to technical science audiences, communities, resource managers, and the general public. We led the development of the 10-year proposal, integrating GWA and Herring Research and Monitoring for the 2022-2031 EVOSTC request for proposals focused on long-term research and monitoring of EVOS injured resources.

The PMT communicated GWA monitoring activities and findings to Trustee Agencies and other resource managers through presentations, meeting participation, a newsletter, and development of graphics for each of the components. We developed and widely distributed a newsletter titled *Quarterly Currents*. During this 5-year funding period, Program Management and GWA PIs enhanced relationships with Trustee Agencies and demonstrated the value of our long-term monitoring program. By enhancing these relationships and building new partnerships, we have greatly increased funding from sources outside of EVOSTC.

Acting as the fiscal agent for the non-Trustee organizations within GWA is among our most important roles in fiscal management through the PWSSC. Without PWSSC as the fiscal agent, EVOSTC would need to administer separate contracts with each non-Trustee organization. PWSSC provides this service by distributing EVOSTC funds that are passed through a NOAA grant, improving efficiency and greatly reducing administrative work for the EVOSTC. In all five years of this funding cycle, PWSSC issued and managed subaward contracts for all non-Trustee Agency projects. Annual federal single audits were completed in every program year. Project spending for all subawards was monitored and assistance was provided to the program overall with budget reconciliation, tracking of cumulative spending, and requests for line-item transfers or transfers between projects.

The PMT oversaw outreach and community involvement during this funding cycle. The GWA website was the primary outreach tool based on the requirements in the request for proposals. Project pages were updated annually with recent findings and brief interpretations of the findings. A “Latest News” section was added to the website. This section was updated as GWA program scientists and projects were highlighted in local or national news or on agency news releases or website profiles. During the funding cycle, 48 articles were added. The website was also updated regularly with GWA publications and reports.

The PMT led the many GWA article contributions to *Delta Sound Connections*, a newspaper-style periodical produced annually by PWSSC and distributed widely throughout PWS, the

Copper River watershed, and adjacent areas. *Delta Sound Connections* was available for free on Alaska state ferries and at the Ted Stevens Anchorage International Airport, Mudhole Smith Airport in Cordova, Begich Boggs Visitor Center at Portage Glacier, and a variety of sites in Girdwood, Glenallen, Copper Center, and Valdez. Article topics ranged from what we do in GWA, new findings, and highlights to the value of long-term research and monitoring in understanding ecosystem change and recovery of EVOS injured resources.

Engagement with Alaska Native communities affected by the spill was a priority during this funding cycle. The GWA program outreach team planned to visit communities in Kachemak Bay during 2018 and PWS in 2020. Project teams visited Seldovia and Port Graham in Kachemak Bay as scheduled but were unable to visit Chenega or Tatitlek in PWS because of the coronavirus pandemic. Chugachmiut Heritage Preservation local education coordinators held meetings with PWS and Kachemak Bay village elders and other community members in conjunction with the Kachemak Bay Science Symposium, and Chugachmiut local education coordinators and elders attended the conference. Members of the GWA PMT and several GWA scientists attended these gatherings to learn about ecosystem change from Tribal members, hear what questions Tribal members had about recovery from the spill and ecosystem change since the spill, and answered questions asked of them by Tribal members.

The combined PM I and II projects demonstrate how a small and integrated leadership team can help scientists collaborate, synthesize their findings, and share their knowledge with a diverse array of stakeholders.

Objective 2: Provide scientific data, data products, and outreach to management agencies and a wide variety of users.

The PMT and project scientists worked together to share GWA program findings with management agencies, other scientists, spill affected communities, and the public. The following is a summary of outreach efforts; see individual project reports for additional details.

As a program focused on long term environmental monitoring, time series were an important method of demonstrating changes over time. By the end of this funding period, projects from all three GWA components were contributing time series (Table 2) to the annual GOA Ecosystem Status Report (see Ferris and Zador 2020), totaling 21 separate metrics, that is presented to the North Pacific Fishery Management Council to help make science-based fishery management decisions. The contributions in 2020 were particularly significant because GWA successfully completed over half of their typical survey efforts, whereas nearly all agency cruises and fieldwork were canceled.

Table 2. Time series indicators developed by Gulf Watch Alaska (GWA) projects for National Oceanic and Atmospheric Administration (NOAA) Ecosystem Status Reports (ESR) and Ecosystem and Socioeconomic Profiles (ESP).

	GWA Component	Ecosystem Indicator	NOAA Report
1	Environmental Drivers	GAK1 temperature	ESR
2	Environmental Drivers	GAK1 salinity	ESR
3	Environmental Drivers	Seward Line temperature	ESR
4	Environmental Drivers	Prince William Sound (PWS) surface temperature	ESR
5	Environmental Drivers	Kachemak Bay temperature	ESR
6	Environmental Drivers	Copepod community size	ESP
7	Environmental Drivers	Mesozooplankton biomass	ESP
8	Environmental Drivers	Large calenoid copepod abundance	ESR
9	Environmental Drivers	Euphausiid abundance	ESR
10	Environmental Drivers	Large diatom abundance	ESP
11	Environmental Drivers	Kachemak Bay saxitoxin in shellfish	ESR
12	Environmental Drivers	Kachemak Bay paralytic shellfish toxicity	ESR
13	Pelagic Ecosystem	Sablefish growth index	ESP
14	Pelagic Ecosystem	Black-legged kittiwake diet	ESR
15	Pelagic Ecosystem	Black kittiwake reproductive success	ESR
16	Pelagic Ecosystem	Rhinoceros auklet diet	ESR
17	Pelagic Ecosystem	Rhinoceros auklet reproductive success	ESR
18	Pelagic Ecosystem	Pelagic cormorant reproductive success	ESR
19	Pelagic Ecosystem	PWS humpback whale encounter rate	ESR
20	Nearshore Ecosystem	Sea star densities	ESR
21	Nearshore Ecosystem	Rockweed cover	ESR

With the understanding that illustrations can often depict complex ideas that are difficult to convey in words, the PMT led a process of developing graphic illustrations for each of the components. The Nearshore component graphic was completed during the FY12-16 funding period and the environmental drivers and Pelagic component graphics were completed during the FY17-21 funding period (Fig. 27).

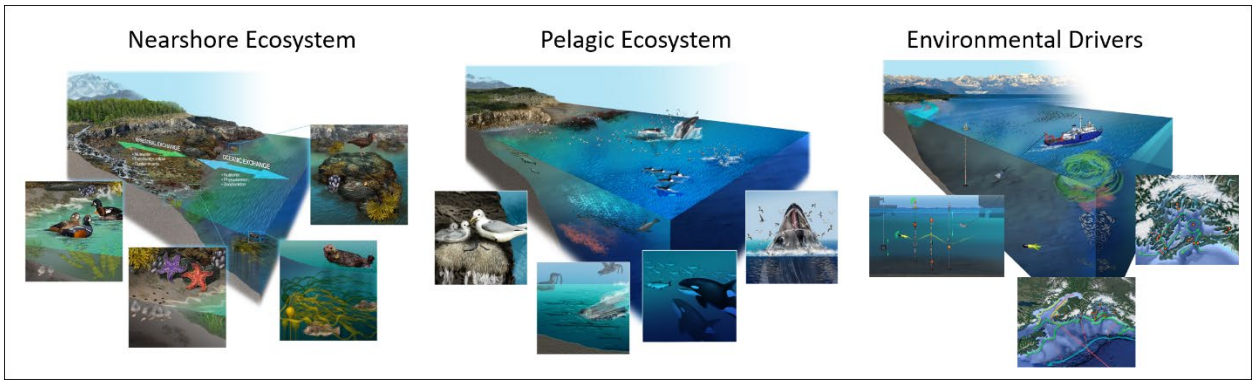

Figure 27. Graphic illustrations of each Gulf Watch Alaska component.

The PMT developed and distributed a newsletter titled *Quarterly Currents* to EVOSTC staff, science panel members, and public advisory committee members; GWA sponsoring agency public relations personnel; HRM PIs; PWS and Cook Inlet Regional Citizens' Advisory Council staff and board members; agency representatives; and others who requested to be included in the distribution. The newsletter provided highlights of GWA program activities each quarter. All *Quarterly Currents* newsletters are available publicly on the GWA website (https://gulfwatchalaska.org/resources/quarterly-currents-newsletter/).

PMT members also attended and presented at scientific conferences. The primary conference was the Alaska Marine Science Symposium held in Anchorage in January each year. The PMT also helped coordinate and participated in a GOA workshop at an Ocean Sciences conference. In addition to AMSS, GWA scientists gave more than 300 presentations at a wide range of scientific conferences, resource agency management meetings, university seminars, and other venues. Collectively, GWA scientists presented program findings to a global array of scientists ranging from oceanographers to fisheries and wildlife biologists.

Through the course of the GWA program, the PMT and PIs improved relationships with Trustee Agencies and demonstrated the value of the long-term monitoring program. Because of these relationships we have leveraged new partnerships and increased funding from sources outside of EVOSTC (Fig. 28).

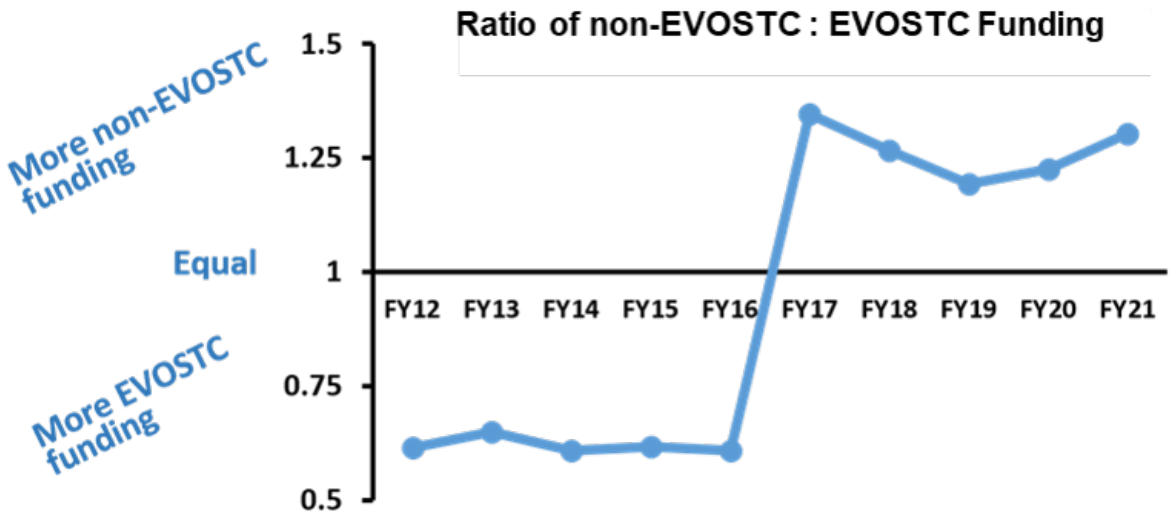

Figure 28. The ratio of funding from the Exxon Valdez Oil Spill Trustee Council (EVOSTC) and other sources for the Gulf Watch Alaska program showing that over the 10-year funding period the program leveraged more funding from non-EVOSTC sources than EVOSTC funding.

Outreach to the public, particularly to spill affected and Alaska Native communities, was particularly important to GWA program scientists to share general knowledge about what is happening in the northern GOA following EVOS. Table 3 summarizes GWA program outreach efforts during the FY17-21 funding cycle.

Table 3. Gulf Watch Alaska scientist outreach activities during the FY17-21 funding cycle, including presentations in Alaska Native and spill affected communities, other public presentations, popular articles, news stories, internet-based outreach, and other forms of public engagement.

Location	Additional Information
Engagements with Spill Affected and Native Communities	
School visit, Chenega School, Chenega, Alaska	Presentations by Arimitsu, Danielson, Moran, and Olsen
Kachemak Bay Shorebird Festival	Presentations by Cushing, Labunski, and Kuletz
Chugachmiut Heritage Preservation meetings with Prince William Sound and Kachemak Bay village elders	Participation by Aderhold, Buckelew, Guo, Holderied, Hondolero, Konar, and Iken

Location	Additional Information
Community discussion with elders, Port Graham, Alaska	Participation by Aderhold, Coletti, Holderied, Konar, Iken, and Weitzman
Community science presentations, Seldovia, Alaska	Participation by Aderhold, Kaler, Konar, and Iken
Kachemak Bay Campus, University of Alaska Anchorage, public lecture series	Presentations by Aderhold, Lindeberg, Robinson, and Holderied
Chugach Regional Resources Commission annual gathering, virtual	Presentation by Suryan
School visit, Fireweed Academy, Homer, Alaska	Presentation by Weitzman
Other Presentations	
Whalefest, Sitka, Alaska	Annual festival in Sitka; Presentations by Arimitsu, Moran, and Suryan
National Park Service Opportunities for Lifelong Learning Education class	Presentation by Coletti
Alyeska Pipeline Service Company oiled wildlife training program	Presentation by Coletti
School visit, BEST Homeschool, Fairbanks, Alaska	Presentation by Corliss
School visit, Eagle River High School oceanography classes, Eagle River, Alaska	Presentation by Cushing
Osher Lifelong Learning Institute, Fairbanks, Alaska	Presentation by Danielson
Public outreach event, Fairbanks, Alaska	Presentations by Konar and Iken
North Pacific Fishery Management Council	Presentation by Lindeberg
University of Alaska Anchorage lectures	Presentations by Matkin
Juneau Marine Naturalists Symposium, Juneau, Alaska	Presentations by Moran and Suryan
Whale Tales, Kapalua, Hawaii	Presentation by Moran
University of Alaska seminar series, Juneau, Alaska	Presentation by Moran

Location	Additional Information
Oil spill tabletop exercise for Prince William Sound, virtual	Participation by Lindeberg and Moran
Naturalist training, Seward, Alaska	Presentations by Olsen
Cruise ship presentations	Presentations by Olsen
Juneau Yacht Club, Juneau, Alaska	Presentation by Suryan
Ranger training, Gustavus, Alaska	Presentation by Weitzman
Whale Tales, Kapalua, Hawaii	Presentations by Moran
Popular Articles	
Delta Sound Connections	Annual publication by Prince William Sound Science Center with regional distribution and availability online; Gulf Watch Alaska included 4-5 articles each year by a variety of contributors, Delta Sound Connections
PICES Press	Article about the continuous plankton recorder program led by Batten, PICES Press-CPR; article about copepod responses to the Pacific marine heatwave, PICES Press-Copepods
Anchorage Daily News	Op Ed prepared by Danielson, ADN-Danielson Op Ed
News Stories	
Seattle Times	Article about the *Exxon Valdez* oil spill with section on killer whales including an interview with Matkin, Seattle Times-EVOS 30 years
Science Magazine	Article about the "Blob", also known as the Pacific marine heatwave, that includes interviews with Hopcroft and Arimitsu, Science Magazine-The "Blob"
Alaska Public Media	Story about sea star wasting disease in Kachemak Bay including interviews with Konar and Weitzman, Alaska Public Media-Sea star wasting; Story about killer whale acoustic monitoring including an interview with Myers; Alaska Public Media-Killer whale acoustics
Anchorage Daily News	Article about an interaction between a sea otter and killer whale in Kachemak Bay including interviews with Olsen and Weitzman, Anchorage Daily News-Sea otter/killer whale interaction; Article about killer whale acoustic monitoring featuring interview with Myers, Anchorage Daily News-Orca whale communications

Location	Additional Information
Fairbanks Daily News Miner	Article about killer whale acoustic monitoring featuring interview with Myers, Fairbanks Daily News Miner-Voices of killer whales
Anchorage Press	Article about Prince William Sound oceanography featuring an interview with Campbell, Anchorage Press-Prince William Sound oceanography
The Guardian	Article about the continuous plankton recorder program including an interview with Ostle, The Guardian-CPR program
Web Stories, Blogs, Podcasts, etc.	
Alaska Fisheries Science Center web stories	Web story about lingering oil project, AFSC-Lingering oil; Web story about Deep Sea Research II special issue on the Gulf of Alaska, AFSC-GOA special issue; Web story about Dall's porpoise range expansion, AFSC-Dall's porpoise
Seattle Aquarium blog	Blog post documenting experience with nearshore team, Seattle Aquarium-Katmai
National Oceanic and Atmospheric Administration (NOAA) Fisheries blog	Blog post about how humpback whales responded to fewer tourists, NOAA Fisheries-humpback whale response to tourists
NOAA National Centers of Coastal and Ocean Science (NCCOS) story map	Story map about sea otters, NCCOS-sea otter
NOAA NCCOS State of Kachemak Bay annual newsletter	Newsletter about Kachemak Bay, State of Kachemak Bay 2019, State of Kachemak Bay 2020, State of Kachemak Bay 2021
Humpback Chronicles podcast	Podcast interview about humpback whales featuring Moran, Humpback chronicles-Moran interview
National Park Service (NPS) web articles	Series of articles featuring nearshore subjects, NPS-Mussel abundance, NPS-Sea otter monitoring, NPS-Black oystercatcher chick diet, NPS-Sea otter research and management, NPS-Mussel monitoring, NPS-Sea star assemblages, NPS-Marine heatwaves, NPS-marine heatwave linked to seabird die-off, NPS-Nearshore monitoring, NPS-Razor clams, NPS-Marine heatwave impacts, NPS-Clam genes, NPS-sea otter population collapse
Conservation Connection podcast	Podcast interview about the marine heatwave and forage fish featuring Suryan, Conservation Connection-Forage fish in hot water

Location	Additional Information
NPS story map	Story map about the seabird die-off, NPS-Seabird die-off story map
Alaska Science Pod podcast	Podcast interview about killer whale acoustic monitoring featuring Myers, Alaska Science Pod-Killer whale acoustics
Other	
Alaska Native Science and Engineering Program student mentoring	Arimitsu and Schoen mentored a student performing at-sea bird surveys, acoustic trawl surveys, and oceanographic sampling
Film for Princess Cruise Lines	Film on killer whale research in Alaska
Gulf Watch Alaska Quarterly Currents	Quarterly newsletter emailed to a diverse group of resource managers and shared on the Gulf Watch Alaska website, Quarterly Currents Newsletter

Objective 3: Develop science synthesis products to assist management actions, inform the public and guide monitoring priorities for the next 15 years.

GWA was uniquely positioned to understand ecosystem-level changes during one of the most significant climate events in the GOA in recent decades. The 2014-2016 PMH was the longest lasting heatwave globally in recent decades (Hobday et al. 2018), occurring in GWA's first 5-year period. The second 5-year period covered in this report included shorter duration heatwaves along with cooling periods. These unique events provided a unifying theme for the GWA Science Coordinator and PIs to evaluate ecosystem response and recovery to these major perturbations. We demonstrated in four synthesis publications that effects, both positive and negative, were evident throughout the food webs, from offshore to intertidal domains, and that many responses persisted after heatwaves subsided.

The PMH that lasted from 2014 through 2016 became the resounding theme for GWA's synthesis report (Suryan et al. 2019). The GWA team developed four chapters and an executive summary around this theme. Following submission of the draft report, the EVOSTC Science Panel held a workshop with GWA PMT, PIs, and SRP to review and discuss the findings. The resulting final report and publications were improved by the input from the EVOSTC Science Panel and Science Director.

The GWA program published four papers from the respective chapters of the synthesis report (Table 4; Arimitsu et al. 2021, Suryan et al. 2021, Weitzman et al. 2021, Danielson et al. 2022). Each paper focused on a different aspect of the effects of the PMH on the GOA. Danielson et al. (2022) incorporated data from GWA environmental drivers and nearshore components with data from other sources to investigate thermal variability in the northern GOA nearshore, coastal, and offshore waters over short and long time scales. Weitzman et al. (2021) used multiple datasets

collected by the nearshore component at four study sites to evaluate the intertidal response of species to the PMH. Arimitsu et al. (2021) included data from the pelagic and environmental drivers components, HRM, and other sources to evaluate the effects of the PMH on forage fish species and top-level predators in the pelagic ecosystem. Suryan et al. (2021) evaluated 187 time series from within GWA, HRM, and other research and monitoring efforts to evaluate the northern GOA ecosystem response to the Pacific marine heatwave (Figs. 29 and 30).

Table 4. The science synthesis report submitted in the third year of the funding cycle included four chapters that fully integrated Gulf Watch Alaska monitoring components. Some chapters incorporated data from the Herring Research and Monitoring program and programs outside of Exxon Valdez Oil Spill Trustee Council funding. The report focused on a major marine heatwave in the northern Gulf of Alaska which was a major ecological perturbation affecting recovery of resources injured by the Exxon Valdez oil spill. The manuscript chapters were individually published in 2021 and 2022 and each included 50-200 times series of physical and biological metrics.

Chapter Title	**Lead Author**	**Number Authors**	**Gulf Watch Alaska Components**	**Journal**
Temperature variations in the northern Gulf of Alaska across synoptic to century-long time scales	Danielson	8	Environmental Drivers (ED), Nearshore[a]	Deep-Sea Research, Part II
Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska	Weitzman	9	Nearshore	Frontiers in Marine Science
Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators	Arimitsu	22	Pelagic, ED, Herring Research and Monitoring (HRM)[a]	Global Change Biology
Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska	Suryan	49	Pelagic, ED, Nearshore, HRM[a]	Scientific Reports

[a]Included data and/or co-authors from outside the Gulf Watch Alaska and HRM programs.

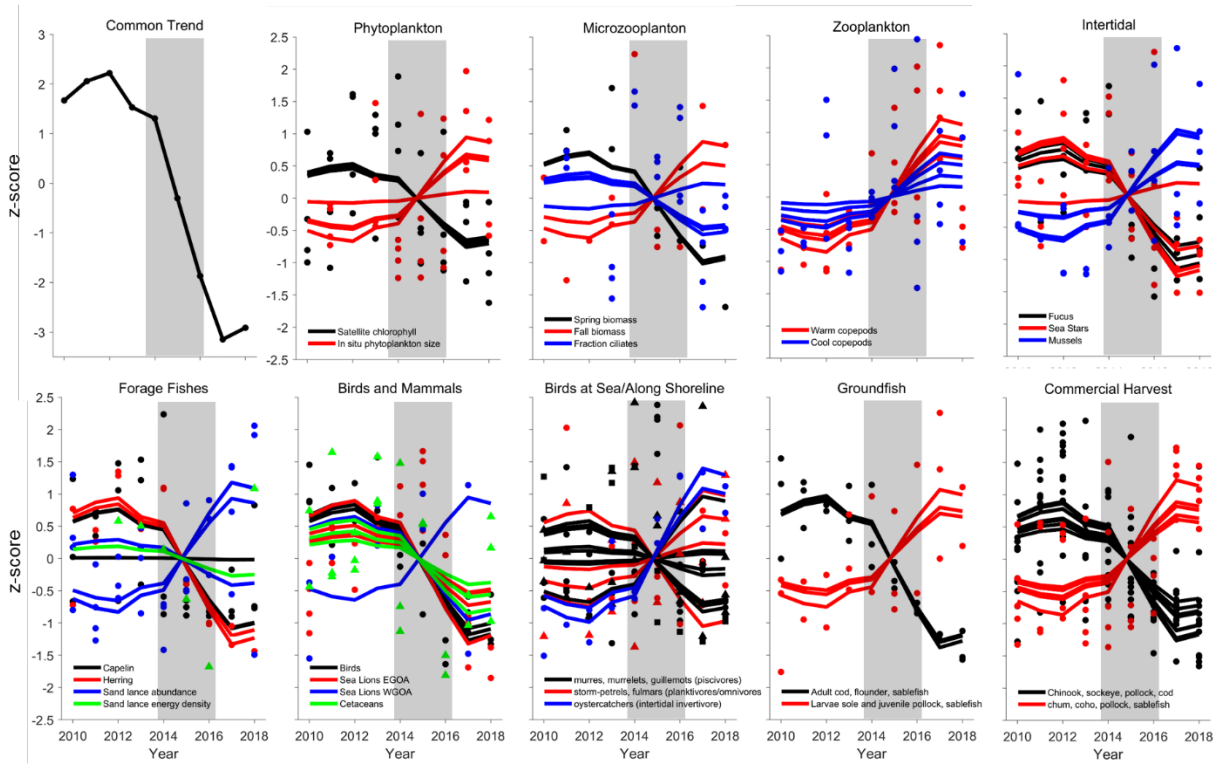

Figure 29. Trends (lines) from dynamic factor analysis fit to annual values (points) in key biological time series during the first 10 years of Gulf Watch Alaska for key taxonomic groups. Grey shading represents the 2014–2016 northeast Pacific marine heatwave. Values are z-score standardizations so the y-axis is unitless. Figures from Suryan et al. (2021).

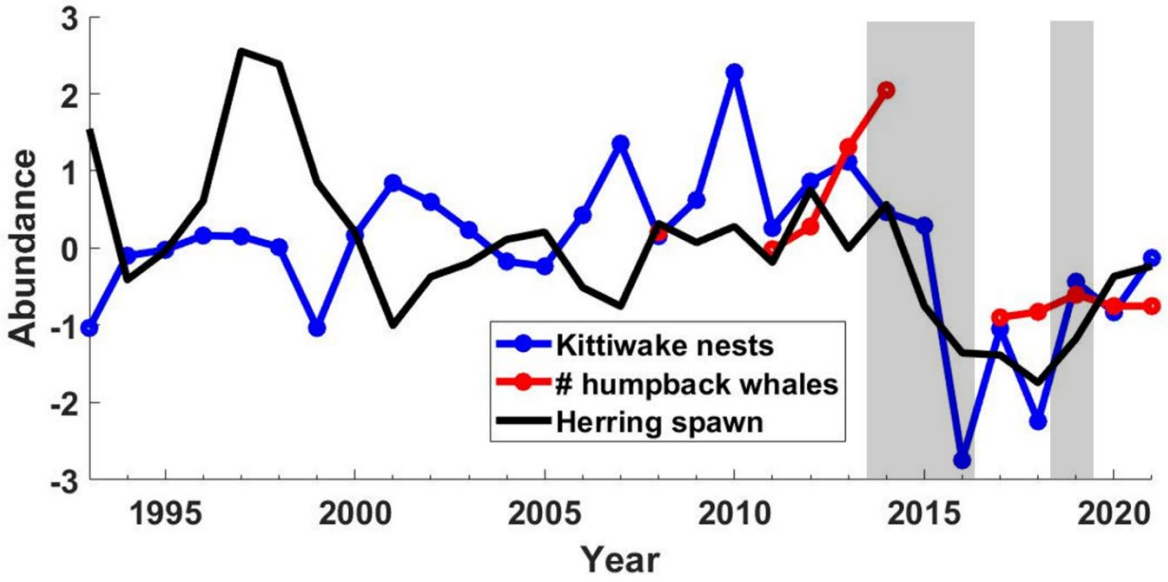

Figure 30. Long-term trends in herring and herring-dependent predators in Prince William Sound. Grey shading represents the 2014–2016 and 2019 northeast Pacific marine heatwave. Values are z-score standardizations so the y-axis is unitless. Figure modified from Suryan et al. (2021).

GWA led the completion of the third installment in a series of special issues dedicated to understanding ecosystem processes in the GOA. Special issue 3 (DSRII volume 206, Lindeberg et al. 2022) presented new findings from GOA Integrated Ecosystem Research Program's final synthesis phase and complementary work from other large multidisciplinary programs in the GOA, including GWA, HRM, and the National Science Foundation's NGA LTER. This special issue complements the first GWA-lead issue published in 2018 (DSRII volume 147, Aderhold et al. 2018). Overall, these DSRII special issues establish a significant foundation of information upon which future scientists and resource managers will rely, especially as the GOA ecosystem faces accelerating environmental change.

Objective 4: Continue to build on collaborations between the GWA and HRM programs, as well as other Trustee program focus areas.

The Research Workspace, managed by the Data Management program, was a critical feature for file sharing and archiving. Program Management files in the Research Workspace were available to all GWA program team members. The Research Workspace was used by monitoring project teams to store data and metadata and provide finalized data to data management team members for annual publication on the GOA Data Portal and by the PMT to share GWA meeting agendas and notes, presentations, work plan and report templates, program photographs, outreach activities, publications, and other important files. The PMT also used the Research Workspace to

submit draft and final deliverables (work plans, annual reports, synthesis reports, and final reports) with EVOSTC staff, providing a permanent record of deliverables.

The GWA PMT and Data Management program staff worked closely to ensure GWA projects met EVOSTC requirements for data publication on AOOS's GOA data portal and DataONE (where finalized data are published with a digital object identifier [DOI]). Data Management program team members were included in the GWA program email distribution list and were invited to attend and present at all GWA program team meetings. Data Management team members met one-on-one with GWA PIs during annual meetings to discuss data deliverables. The Data Management Program Lead provided the GWA PMT with updates on project data deliverable status, allowing PMT members to coordinate with PIs if data deliverables were falling behind.

The GWA PMT coordinated closely with HRM Lead Scott Pegau. Scott was included in the GWA program email distribution list and GWA PMT members were included in the HRM email distribution list. Scott was included in GWA PMT meetings which included discussion topics that affected the HRM program. Scott presented HRM program updates during GWA PI meetings and he invited the GWA Program Lead to present GWA program updates at HRM PI meetings. GWA and HRM annual PI meetings were scheduled to allow PIs and team members from both programs to interact and attend each other's sessions. Interactions between GWA and HRM PIs increased with science synthesis. During this period, GWA and HRM held joint synthesis meetings and PIs from both programs contributed to chapters of each other's synthesis reports to EVOSTC and subsequent peer reviewed publications. During the final year of the 5-year funding cycle the programs integrated further as the EVOSTC FY22-31 Invitation called for the merging of the two programs into one long-term research and monitoring program.

Objective 5: Leverage partnerships with outside agencies and groups to integrate data and expand capacity through collaborative efforts.

The four papers published from the science synthesis effort (Arimitsu et al. 2021, Suryan et al. 2021, Weitzman et al. 2021, Danielson et al. 2022) and the journal special issues (Aderhold et al. 2018; Lindeberg et al. 2022) provide examples of GWA program scientists leveraging partnerships. Another example of the GWA program leveraging partnerships and expanding capacity through collaboration is mentoring young scientists. Long term monitoring programs provide important opportunities to mentor young scientists at undergraduate and graduate student levels, and postdoctoral scholars. GWA program projects mentored numerous young scientists, as summarized in Table 5. The University of Alaska Southeast (UAS) and NOAA Partnership in Education Program (PEP), UA Alaska Native Science and Engineering (ANSEP) program, and UAF Biomedical Learning & Student Training (BLaST) program specifically targeted undergraduates from rural Alaska and of Alaska Native heritage.

Table 5. Summary of Gulf Watch Alaska (GWA) principal investigators mentoring students associated with monitoring projects funded by the Exxon Valdez Oil Spill Trustee Council.

Degree	Student Affiliation	Topic
Undergraduate internship	University of Alaska Southeast (UAS) & National Oceanic and Atmospheric Administration (NOAA) Partnership in Education Program (PEP)	Humpback whale isotopes
	UAS	GWA-Herring Research & Monitoring (HRM) aerial survey
	University of Alaska Fairbanks (UAF) College of Fisheries and Ocean Sciences (CFOS)	Mussel size frequency
	Alaska Pacific University (APU)	Mussel core size and counts
	APU	Sea otters
	APU	Sea otters
	APU	Mussels
	North Gulf Oceanic Society (NGOS)	Hydrophone data sorting
	NGOS	Programing, data input
	NGOS	Geographic Information System (GIS), data archiving, field work
	NGOS	Data quality control, error checking field acoustics
	NOAA Hollings Scholarship program	Visualizing nearshore data
	NOAA Hollings Scholarship program	Nearshore fish
	American Academy of Underwater Sciences	Nearshore communities
	University of Alaska (UA) Alaska Native Science & Engineering Program (ANSEP)	Lab & fieldwork
	UAF Biomedical Learning & Student Training (BLaST)	Clam populations
	National Science Foundation (NSF) Research Experiences for Undergraduates (REU)	Circulation, fresh water distribution
Master of Science	UAS	Sea otters
	UAF CFOS	Mussel demographics

Degree	Student Affiliation	Topic
	UAF CFOS	Sea star wasting disease
	UAF CFOS	Mussel dynamics in nearshore communities
	UAF CFOS	Intertidal communities
	UAF CFOS	Freshwater pathways
	UAF CFOS	Stratification
	UAF CFOS	Jellyfish
	UAF CFOS	Neocalanus copepods
	UAF CFOS	Larvaceans & pteropods
	UAF CFOS	In situ plankton imaging
	NGOS/UAF CFOS	Killer whale acoustics
	Simon Fraser University (SFU)	Black oystercatchers
	SFU	Marine birds (Barrow's goldeneyes)
Post-doctoral scholar	UAF CFOS	Prince William Sound ecosystem model
	USGS	Nearshore Component synthesis
Artist intern	USGS	Fall integrated predator-prey survey

CONCLUSIONS

Over the past 10-years the organizational structure of GWA has been effective and resulted in a productive, integrated ecosystem monitoring and research program. GWA has made significant contributions to scientific understanding of the northern GOA ecosystem and has shared its findings widely among Trustee and management agencies, the scientific community, residents of the spill affected region, and the public. GWA was fortuitously positioned to document the most significant, contemporary ecosystem perturbations in the GOA: the marine heatwaves of 2014-2016 and 2019. Results from GWA clearly demonstrate these events effected the recovery potential of species still listed as injured by the EVOS and that as of 2021, there are still lingering effects. In the coming years, continued monitoring and research efforts by GWA will be critical in understanding whether PWS and the GOA return to a pre-heatwave state or an alternate regime, as well as the extent to which the system has recovered from EVOS.

ACKNOWLEDGEMENTS

We thank the *Exxon Valdez* Oil Spill Trustee Council and staff for their support of GWA and their unwavering assistance with the myriad administrative tasks required to keep the program going year after year. We are indebted to the many investigators, project leads, component leads, and Science Review Panel members whose dedication for conducting and producing the best possible science makes GWA's impact far greater than the sum of its parts. We thank Scott Pegau and scientists within the HRM program for collaborating with GWA investigators on many fronts. Thanks also to Axiom Data Science staff for making the task of data archiving as simple as possible. Thanks to all the agencies and organizations who provided in-kind support for GWA investigators and leveraged resources. Thanks to the many others who supported the work of the GWA in background roles. Findings and conclusions presented by the author(s) are their own and do not necessarily reflect the views or position of the *Exxon Valdez* Oil Spill Trustee Council.

LITERATURE CITED

Aderhold, D. G. R., M. R. Lindeberg, K. Holderied, and W. S. Pegau. 2018. Spatial and temporal ecological variability in the northern Gulf of Alaska: What have we learned since the *Exxon Valdez* oil spill? Deep Sea Research Part II: Topical Studies in Oceanography 147:3-8. https://doi.org/10.1016/j.dsr2.2017.11.015.

Arimitsu, M. L., and J. F. Piatt. 2014. Forage fish populations in Prince William Sound: Designing efficient monitoring techniques to detect change. *In* Quantifying temporal and spatial variability across the Northern Gulf of Alaska to understand mechanisms of change. Gulf Watch Alaska Science Synthesis Report.

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, W.S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2021. Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Global Change Biology. https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.15556.

Arimitsu, M. L., J. F. Piatt, S. Hatch, C. E. Marsteller, D. Donnelly, and S. Whelan. 2023. Monitoring Long-term Changes in Forage Fish Distribution, Abundance and Body Condition in Prince William Sound. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-C), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Barbeaux, S. J., K. Holsman, and S. Zador. 2020. Marine heatwave stress test of ecosystem-based fisheries management in the Gulf of Alaska Pacific cod fishery. Frontiers in Marine Science 7 https://doi.org/10.3389/fmars.2020.00703.

Batten, S. D., R. Clark, J. Flinkman, G. Hays, E. John, A. W. G. John, T. Jonas, J. A. Lindley, D. P. Stevens, and A. Walne. 2003. CPR sampling: The technical background, materials and methods, consistency and comparability. Progress in Oceanography 57:193–215. https://doi.org/10.1016/j.pocean.2003.08.004.

Campbell, R. W. 2023. Monitoring the Oceanographic Conditions of Prince William Sound. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-G), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H. A., J. L. Bodkin, D. H. Monson, B. E. Ballachey, and T. A. Dean. 2016. Detecting and inferring cause of change in an Alaska nearshore marine ecosystem. Ecosphere 7: e01489. https://doi.org/10.1002/ecs2.1489.

Coletti, H., D. Esler, B. Ballachey, J. Bodkin, G. Esslinger, K. Kloecker, D. Monson, B. Robinson, S. Traiger, K. Iken, B. Konar, T. Dean, M. Lindeberg, and B. Weitzman. 2023. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project 2017-2021 Final Report (Restoration Project 21120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Danielson, S. L. 2023. Long-term monitoring of oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK-1. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-I), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Danielson, S. L., T. D. Hennon, D. H. Monson, R. M. Suryan, R. W. Campbell, S. J. Baird, K. Holderied, and T. J. Weingartner. 2022. Temperature variations in the northern Gulf of Alaska across synoptic to century-long time scales. Deep Sea Research Part II: Topical Studies in Oceanography 203:105155. https://doi.org/https://doi.org/10.1016/j.dsr2.2022.105155.

Esler, D., B. E. Ballachey, C. Matkin, D. Cushing, R. Kaler, J. Bodkin, D. Monson, G. Esslinger, and K. Kloeker. 2018. Timelines and mechanisms of wildlife population recovery following the *Exxon Valdez* oil spill. Deep Sea Research Part II: Topical Studies in Oceanography 147:36-42 https://doi.org/10.1016/j.dsr2.2017.04.007.

Esslinger, G. G., B. H. Robinson, D. H. Monson, R. L. Taylor, D. Esler, B. P. Weitzman, and J. Garlich-Miller. 2021. Abundance and distribution of sea otters (*Enhydra lutris*) in the Southcentral Alaska stock, 2014, 2017 and 2019. U. S. Geological Survey Open-File Report 2021–1122. https://doi.org/10.3133/ofr20211122.

Exxon Valdez Oil Spill Trustee Council (EVOSTC). 2015. Invitation for proposals fiscal years 17-21. *Exxon Valdez* Oil Spill Trustee Council, December 1.

Ferris, B. E., and S. Zador. 2020. Ecosystem status report 2020: Gulf of Alaska stock assessment and fishery evaluation report, North Pacific Fishery Management Council 1007 West Third Ave., Suite 400, Anchorage, Alaska 99501.

Garlich-Miller, J. L., G. G. Esslinger, and B. P. Weitzman. 2018. Aerial surveys of sea otters (*Enhydra lutris*) in lower Cook Inlet, Alaska, May 2017. U. S. Fish Wildlife Service, Marine Mammals Management Technical Report: MMM 2018-01, Anchorage, Alaska, 22pp.

Heintz, R. A., M. Lindeberg, and A. McCarrel. 2023. Extending the timeline for lingering oil in Prince William Sound. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21200014-P). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Hobday, A. J., E. C. J. Oliver, A. Sen Gupta, J. A. Benthuysen, M. T. Burrows, M. G. Donat, N. J. Holbrook, P. J. Moore, M. S. Thomsen, T. Wernberg, and D. A. Smale. 2018. Categorizing and naming marine heatwaves. Oceanography 31:162–173. https://doi.org/10.5670/oceanog.2018.205.

Holderied, K., M. Renner, C. Guo, D. Hondolero, J. Schloemer, S. Baird, and C. Walker. 2023. Long-term monitoring of oceanographic conditions in Cook Inlet/ Kachemak Bay. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-J), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Hopcroft, R. R., S. L. Danielson, S. L. Strom, and K. Kuletz. 2023. The Seward Line: Marine ecosystem monitoring in the Northern Gulf of Alaska, 2017-2021. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 21120114-L). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Janzen, C. D., R. Bochenek S. Buckelew, A. Canino, and C. Turner, 2023. *Exxon Valdez* Oil Spill Data Management Program Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120113), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Kaler, R. S. A., D. A. Cushing, E. Labunski, and K. Kuletz. 2023. Prince William Sound and Gulf of Alaska Marine Bird Surveys. *Exxon Valdez* Oil Spill Restoration Project Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-M), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Kelley, J. 2015. An Examination of Hydrography and Sea Level in the Gulf of Alaska. Thesis, University of Alaska Fairbanks, Fairbanks, Alaska, USA.

Lindeberg, M. R., M. Baker, D. M. S. Dickson, D. G. Kimmel, O. A. Ormseth, S. L. Strom, and R. M. Suryan. 2022. Long-term monitoring and integrated research – Understanding ecosystem processes in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 206:105208. https://doi.org/10.1016/j.dsr2.2022.105208.

Lindeberg, M., K. Hoffman, D. Aderhold, and R. Suryan. 2023. Program Management I – Program Coordination and Science Synthesis and Program Management II – Administration, Science Review Panel, PI Meeting Logistics, Outreach, and Community Involvement. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-A&B), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C. O., J. Durban, D. Olsen, H. Myers, and G. Ellis. 2023. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-N), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C. O., G. M. Ellis, E. L. Saulitis, P. Olesiuk, and S. D. Rice. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the *Exxon Valdez* oil spill in Prince William Sound, Alaska. Marine Ecological Progress Series 356:269–281.

Moran, J. R., J. M. Straley, J. M. Maselko, L. A. Wild, and T. A. Bare. 2023. Long-term monitoring of humpback whale predation on Pacific herring in Prince William Sound. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-O), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Ostle, C., and S. Batten. 2023. Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-D), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Pegau, W. S. 2023. Herring Program – Program Coordination. *Exxon Valdez* Oil Spill Herring Research and Monitoring Program Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120111-A), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Peterson, C. H., S. D. Rice, J. W. Short, D. Esler, J. L. Bodkin, B. E. Ballachey, and D. B. Irons. 2003. Long-term ecosystem response to the *Exxon Valdez* oil spill. Science 19;302(5653):2082-2086. Doi: 10.1126/science.1084282.

Piatt, J. F., J. K. Parrish, H. M. Renner, S. K. Schoen, T. T. Jones, M. L. Arimitsu, K. J. Kuletz, B. Bodenstein, M. Garcia-Reyes, R. S. Duerr, R. M. Corcoran, R. S. A. Kaler, G. J.

McChesney, R. T. Golightly, H. A. Coletti, R. M. Suryan, H. K. Burgess, J. Lindsey, K. Lindquist, P. M. Warzybok, J. Jahncke, J. Roletto, and W. J. Sydeman. 2020. Extreme mortality and reproductive failure of common murres resulting from the northeast Pacific marine heatwave of 2014-2016. PloS ONE 15(1): e0226087. https://doi.org/10.1371/journal.pone.0226087.

Richardson, A. J., A. W. Walne, and A. W. G. John. 2006. Using continuous plankton recorder data. Progress in Oceanography 68:27–74. http://linkinghub.elsevier.com/retrieve/pii/S0079661105001424.

Royer, T. C., and C. E. Grosch. 2006. Ocean warming and freshening in the northern Gulf of Alaska, Geophysical Research Letters 33 (16), L16605, doi:10.1029/2006GL026767.

Schaefer, A. L., and M. A Bishop. 2023. Long-term monitoring of marine bird abundance and habitat associations during fall and winter in Prince William Sound. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-E), *Exxon Valdez* Oil Spill Trustee Council Project, Anchorage, Alaska.

Suryan, R. M., M. L. Arimitsu, H. A. Coletti, R. R. Hopcroft, M. R. Lindeberg, S. J. Barbeaux, S. D. Batten, W. J. Burt, M. A. Bishop, J. L. Bodkin, R. Brenner, R. W. Campbell, D. A. Cushing, S. L. Danielson, M. W. Dorn, B. Drummond, D. Esler, T. Gelatt, D. H. Hanselman, S. A. Hatch, S. Haught, K. Holderied, K. Iken, D. B. Irons, A. B. Kettle, D. G. Kimmel, B. Konar, K. J. Kuletz, B. J. Laurel, J. M. Maniscalco, C. Matkin, C. A. E. McKinstry, D. H. Monson, J. R. Moran, D. Olsen, W. A. Palsson, W. S. Pegau, J. F. Piatt, L. A. Rogers, N. A. Rojek, A. Schaefer, I. B. Spies, J. M. Straley, S. L. Strom, K. L. Sweeney, M. Szymkowiak, B. P. Weitzman, E. M. Yasumiishi, and S. G. zador. 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports 11:1–17. https://doi.org/10.1038/s41598-021-83818-5.

Suryan, R. M., M. R. Lindeberg, and D. R. Aderhold, eds. 2019. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Draft Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Walsh, J. E., R. L. Thoman, U. S. Bhatt, P. A. Bieniek, B. Brettschneider, M. Brubaker, S. Danielson, R. Lader, F. Fetterer, K. Holderied, K. Iken, A. Mahoney, M. McCammon, and J. Partain. 2018. The high latitude marine heat wave of 2016 and its impacts on Alaska. Bulletin of the American Meteorological Society 99:S39-S43. https://doi.org/10.1175/BAMS-D-17-0105.1.

Weingartner, T. J., K. O. Coyle, B. Finney, R. R. Hopcroft, T. E. Whitledge, R. D. Brodeur, M. Dagg, E. Farley, D. Haidvogel, L. Haldorson, A. I. Hermann, S. Hinckley, J. Napp, P. J. Stabeno, T. C. Kline, C. M. Lee, E. Lessard, T. C. Royer, and S. L. Strom. 2002. The Northeast Pacific GLOBEC program: coastal Gulf of Alaska. Oceanography 15:48-63.

Weitzman, B, B. Konar, K. Iken, H. Coletti, D. Monson, R. Suryan, T. Dean, D. Hondolero, and M. Lindeberg. 2021. Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska. Frontiers in Marine Science. https://doi.org/10.3389/fmars.2021.556820.

OTHER REFERENCES

This section includes peer reviewed publications, EVOSTC reports and other significant report contributions, publicly available datasets, scientific presentations, and outreach associated with the project.

Peer reviewed publications

Aderhold, D. R., D. Esler, R. A. Heintz, R. R. Hopcroft, M. R. Lindeberg, and W. S. Pegau. Editors. Spatial and Temporal Ecological Variability in the Northern Gulf of Alaska: What have we learned since the *Exxon Valdez* Oil Spill? Deep Sea Research Part II: Topical Studies in Oceanography, Volume 147, Pages 1-202, ISSN 0967-0645. January 2017. https://www.sciencedirect.com/journal/deep-sea-research-part-ii-topical-studies-in-oceanography/vol/147/suppl/C.

Arimitsu, M. L., K. A. Hobson, D. N. Webber, J. F. Piatt, E. W. Hood, and J. B. Fellman. 2017. Tracing biogeochemical subsidies from glacier runoff into Alaska coastal marine food webs. Global Change Biology 24:387–398. https://doi.org/10.1111/gcb.13875.

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, W. S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2021. Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Global Change Biology. https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.15556.

Arimitsu, M. L., J. F. Piatt, J. T. Thorson, K. Kuletz, G. Drew, S. K. Schoen, D. A. Cushing, C. Kroeger, and W. J. Sydeman. 2023. Joint spatiotemporal models to predict seabird densities at sea. Frontiers in Marine Science. *In Press*.

Batten, S. D., R. Abu-Alhaija, S. Chiba, M. Edwards, G. Graham, R. Jyothibabu, J. A. Kitchener, P. Koubbi, A. McQuatters-Gollop, E. Muxagata, C. Ostle, A. J. Richardson, K. V. Robinson, K. T. Takahashi, H. M. Verheye, and W. Wilson. 2019. A global plankton

diversity monitoring program. Frontiers in Marine Science 6:1–14. https://www.frontiersin.org/article/10.3389/fmars.2019.00321/full.

Batten, S. D., C. Ostle, P. Hélaouët, and A. W. Walne. 2022. Responses of Gulf of Alaska plankton communities to a marine heat wave. Deep Sea Research Part II: Topical Studies in Oceanography 195:105002. https://doi.org/10.1016/j.dsr2.2021.105002.

Batten, S. D., D. E. Raitsos, S. Danielson, R. R. Hopcroft, K. Coyle, and A. McQuatters-Gollop. 2018. Interannual variability in lower trophic levels on the Alaskan Shelf. Deep Sea Research II. 147:58–68. https://doi.org/10.1016/j.dsr2.2017.04.023.

Bodkin, J. L., H. A. Coletti, B. E. Ballachey, D. H. Monson, D. Esler, and T. A. Dean. 2018. Variation in abundance of Pacific Blue Mussel (*Mytilus trossulus*) in the Northern Gulf of Alaska, 2006–2015. Deep Sea Research Part II: Topical Studies in Oceanography 147:87-97. https://doi.org/10.1016/j.dsr2.2017.04.008.

Bowen, L., K. Counihan, B. Ballachey, H. Coletti, T. Hollmen, B. Pister, and T. Wilson. 2020. Monitoring nearshore ecosystem health using Pacific Razor Clams (*Siliqua patula*) as an indicator species. PeerJ 8:e8761. https://doi.org/10.7717/peerj.8761.

Bowen, L., A. K. Miles, B. E. Ballachey, S. Waters, J. L. Bodkin, M. Lindeberg, and D. Esler. 2018. Gene transcription patterns in response to low level petroleum contaminants in *Mytilus trossulus* from field sites and harbors in southcentral Alaska. Deep Sea Research Part II: Topical Studies in Oceanography. https://doi.org/10.1016/j.dsr2.2017.08.007.

Bowen L., S. Knowles, K. Lefebvre, M. St. Martin, M. Murray, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, H. Coletti, S. Waters, and C. Cummings. 2022. Divergent gene expression profiles in Alaskan sea otters: an indicator of chronic domoic acid exposure? Oceans 3:401-418. https://doi.org/10.3390/oceans3030027.

Burgess T. L., M. T. Tinker, M. A. Miller, J. L. Bodkin, M. J. Murray, J. A. Saarinen, L. M. Nichol, S. Larson, P. A. Conrad, and C. K. Johnson. 2018. Defining the risk landscape in the context of pathogen pollution: Toxoplasma gondii in sea otters along the Pacific Rim. Royal Society of Open Science 5:171178. http://dx.doi.org/10.1098/rsos.171178.

Burgess, T. L., M. T. Tinker, M. A. Miller, W. A., Smith, J. L. Bodkin, M. J. Murray, L. M. Nichol, J. A. Saarinen, S. Larson, J. A. Tomoleoni, and P. A. Conrad. 2020. Spatial epidemiological patterns suggest mechanisms of land-sea transmission for *Sarcocystis neurona* in a coastal marine mammal. Scientific Reports 10:3683. https://doi.org/10.1038/s41598-020-60254-5.

Campbell, R. W. 2018. Hydrographic trends in Prince William Sound, Alaska, 1960–2016. Deep Sea Research Part II: Topical Studies in Oceanography 147:43-57. https://doi.org/10.1016/j.dsr2.2017.08.014.

Campbell, R. W., P. L. Roberts, and J. Jaffe. 2020. The Prince William Sound Plankton Camera: A profiling *in situ* observatory of plankton and particulates. ICES Journal Marine Science. https://doi:10.1093/icesjms/fsaa029.

Chasco, B. E., Isaac C. Kaplan, Austen C. Thomas, Alejandro Acevedo-Gutiérrez, Dawn P. Noren, Michael J. Ford, M. B. Hanson, J. J. Scordino, S. J. Jeffries, K N. Marshall, A. O. Shelton, C. Matkin, B. J. Burke, and E. J. Ward. 2017. Competing tradeoffs between increasing marine mammal predation and fisheries harvest of Chinook salmon. Scientific Reports 7:15439. https://doi.org/10.1038/s41598-017-14984-8.

Chenoweth, E. M., and K. R. Criddle. 2019. The Economic Impacts of Humpback Whale Depredation on Hatchery-Released Juvenile Pacific Salmon in Southeast Alaska. Marine and Coastal Fisheries 1:62-75. https://doi.org/10.1002/mcf2.10061.

Cieslak, M. C., A. M. Castelfranco, V. Roncalli, P. H. Lenz, and D. K. Hartline. 2020. t-Distributed Stochastic Neighbor Embedding (t-SNE): A tool for eco-physiological transcriptomic analysis. Marine Genomics 51:100723. https://doi.org/10.1016/j.margen.2019.100723.

Coletti, H. A. 2021. Sea otter behavior and its influence on littoral community structure. Pages 139-138 *in* R. Davis and A. Pagano, editors. Ethology of Sea Otters, Springer, New York, New York, USA.

Coletti, H., G. Hilderbrand, J. Bodkin, B. Ballachey, J. Erlenbach, G. Esslinger, M. Hannam, K. Kloecker, B. Mangipane, A. Miller, D. Monson, B. Pister, K. Griffin, K. Bodkin, and T. Smith. 2022. Where land and sea meet: brown bears and sea otters. Frontiers in Young Minds. https://doi.org/10.3389/frym.2022.715993.

Connors, B., M. J. Malick, G. T. Ruggerone, P. Rand, M. Adkison, J. Irvine, R. W. Campbell, and K. Gorman. 2020. Climate and competition influence sockeye salmon population dynamics across the Northeast Pacific Ocean. Canadian Journal of Fisheries and Aquatic Sciences 77:943-949. https://doi.org/10.1139/cjfas-2019-0422.

Counihan, K., L. Bowen, B. Ballachey, H. Coletti, T. Hollmen, and B. Pister. 2019. Physiological and gene transcription assays in combinations: a new paradigm for marine intertidal assessment. PeerJ 7:e7800. https://doi.org/10.7717/peerj.7800.

Coyle, K. O., A. J. Hermann, and R. R. Hopcroft. 2019. Modeled spatial-temporal distribution of productivity, chlorophyll, iron and nitrate on the northern Gulf of Alaska shelf relative to field observations. Deep Sea Research Part II: Topical Studies in Oceanography 165:163–191. https://doi.org/10.1016/j.dsr2.2019.05.006.

Cushing D. A., K. J. Kuletz, L. Sousa, R. H. Day, S. L. Danielson, E. A. Labunski, and R. R. Hopcroft. 2023. Differential response of seabird species to warm- and cold-water events

in a heterogenous cross-shelf environment in the Gulf of Alaska. Marine Ecology Progress Series. *In Press*.

Cushing, D. A., D. D. Roby, and D. B. Irons. 2018. Patterns of distribution, abundance, and change over time in a subarctic marine bird community. Deep Sea Research Part II: Topical Studies in Oceanography 147:148-163. https://doi.org/10.1016/j.dsr2.2017.07.012.

Danielson, S. L., T. D. Hennon, D. H. Monson, R. M. Suryan, R. W. Campbell, S. J. Baird, K. Holderied, and T. J. Weingartner. 2022. Temperature variations in the northern Gulf of Alaska across synoptic to century-long time scales. Deep-Sea Research II: Topical Studies in Oceanography 203:105155. https://doi.org/10.1016/j.dsr2.2022.105155.

Danielson, S. L., D. F. Hill, K. S. Hedstrom, J. Beamer, and E. Curchitser. 2020. Demonstrating a high-resolution Gulf of Alaska ocean circulation model forced across the coastal interface by high-resolution terrestrial hydrological models. Journal of Geophysical Research: Oceans 125:e2019JC015724. https://doi.org/10.1029/2019JC015724.

Danishevskaya, A. Y., O. A. Filatova, F. I. P. Samarra, P. J. O. Miller, J. K. B. Ford, H. Yurk, C. O. Matkin, and E. Hoyt. 2018. Crowd intelligence can discern between repertoires of killer whale ecotypes. Bioacoustics Latest Articles 29:15-27. https://doi.org/10.1080/09524622.2018.1538902.

Davis, R. W., and J. L. Bodkin. 2021. Sea otter foraging behavior. In Davis, R. and A. Pagano, editors. Ethology of Sea Otters, Springer, New York, New York, USA.

Davis, R., J. L. Bodkin, H. A. Coletti, D. H. Monson, S. E. Larson, L. P. Carswell, and L. M. Nichol. 2019. Future direction in sea otter research and management. Frontiers in Marine Science 5. https://doi.org/10.3389/fmars.2018.00510.

Dias, B. S., D. W. McGowan, R. W. Campbell, and T. A. Branch. 2022. Influence of environmental and population factors on Prince William Sound herring spawning phenology. Marine Ecology Progress Series 696:103-117. https://doi.org/10.3354/meps14133.

Doyle, M. J., S. L. Strom, K. O. Coyle, A. J. Hermann, C. Ladd, A. C. Matarese, S. K. Shotwell, and R. R. Hopcroft. 2019. Early life history phenology among Gulf of Alaska fish species: Strategies, synchronies, and sensitivities. Deep-Sea Research Part II: Topical Studies in Oceanography 165:41-73. https://doi.org/10.1016/j.dsr2.2019.06.005.

Du, X., R. W. Campbell, and S. Kibler. 2022. Seasonal changes of microphytoplankton community in Prince William Sound, Alaska in 2019. Estuaries and Coasts 46:388-403. https://doi.org/10.1007/s12237-022-01144-z.

Ducklow, H., M. Cimino, K. H. Dunton, W. R. Fraser, R. R. Hopcroft, R. Ji, A. J. Miller, M. D. Ohman, and H. M. Sosik. 2022. Marine pelagic ecosystem responses to climate variability and change. BioScience 72:827–850. https://doi.org/https://doi.org/10.1093/biosci/biac050.

Esler, D., B. E. Ballachey, C. O. Matkin, D. Cushing, R. Kaler, J. Bodkin, D. Monson, G. G. Esslinger, and K. Kloecker. 2018. Timelines and mechanisms of wildlife population recovery following the *Exxon Valdez* oil spill. Deep Sea Research Part II: Topical Studies in Oceanography 147:36-42. https://doi.org/10.1016/j.dsr2.2017.04.007.

Espinasse, B., B. P. V., Hunt, S. D. Batten, and E. Pakhomov, E. 2019. Defining isoscapes in the Northeast Pacific as an index of ocean productivity. Global Ecology and Biogeography 29:246-261. https://doi.org/10.1111/geb.13022.

Hauri, C., R. Pages, A. M. P. McDonnell, M. F. Stuecker, S. L. Danielson, K. Hedstrom, B. Irving, C. Schultz, and S. C. Doney. 2021. Modulation of ocean acidification by decadal climate variability in the Gulf of Alaska. Communications Earth & Environment 2:191. https://doi.org/10.1038/s43247-021-00254-z.

Hauri, C., C. Schultz, K. Hedstrom, S. Danielson, B. Irving, S. C. Doney, R. Dussin, E. N. Curchitser, D. F. Hill, and C. A. Stock, C. A. 2020. A regional hindcast model simulating ecosystem dynamics, inorganic carbon chemistry, and ocean acidification in the Gulf of Alaska. Biogeosciences 17:3837–3857. https://doi.org/https://doi.org/10.5194/bg-17-3837-2020.

Helser, T., C. Kastelle, A. Crowell, T. Ushikubo, I. J. Orland, R. Kozdon, and J. W. Valley. 2017. A 200-year archaeozoological record of Pacific cod (*Gadus macrocephalus*) life history as revealed through ion microprobe oxygen isotope ratios in otoliths. Journal of Archaeological Science: Reports 21:1236-1246. https://doi.org/10.1016/j.jasrep.2017.06.037.

Hoover, B. A., M. Garcia-Reyes, S. D. Batten, C. L. Gentemann, and W. J. Sydeman. 2021. Spatio-temporal persistence of zooplankton communities in the Gulf of Alaska. PLoS ONE 16:1–24. https://doi.org/10.1371/journal.pone.0244960

Kandel, A., and A. Aguilar-Islas. 2021. Spatial and temporal variability of dissolved aluminum and manganese in surface waters of the northern Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 189-190:104952. https://doi.org/10.1016/j.dsr2.2021.104952.

Kohan, M. L., F. J. Mueter, J. A. Orsi, and M. V. McPhee. 2017. Variation in size, condition, and abundance of juvenile chum salmon (*Oncorhynchus keta*) in relation to marine factors in

Southeast Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 165:340-347. https://doi.org/10.1016/j.dsr2.2017.09.005.

Konar, B., and K. Iken. 2018. The use of unmanned aerial vehicle imagery in intertidal monitoring. Deep Sea Research Part II: Topical Studies in Oceanography 147:79-86. https://doi.org/10.1016/j.dsr2.2017.04.010.

Konar, B., T. J. Mitchell, K. Iken, H. Coletti, T. Dean, D. Esler, M. Lindeberg, B. Pister, and B. Weitzman. 2019. Wasting disease and environmental variables drive sea star assemblages in the northern Gulf of Alaska. Journal of Experimental Marine Biology and Ecology 520:151209. https://doi.org/10.1016/j.jembe.2019.151209.

Larson, S., R. B. Gagne, J. Bodkin, M. J., Murray, K. Ralls, L. Bowen, R. Leblois, S. Piry, M. C. Penedo, M. T. Tinker, and H. B. Ernest. 2021. Translocations maintain genetic diversity and increase connectivity in sea otters, *Enhydra lutris*. Marine Mammal Science 37:1475-1497. https://doi.org/10.1111/mms.12841.

Laurel, B. J., and L. A. Rogers. 2020. Loss of spawning habitat and prerecruits of Pacific cod during a Gulf of Alaska heatwave. Canadian Journal of Fisheries and Aquatic Sciences 77:644-650. https://doi.org/10.1139/cjfas-2019-0238.

Lawson, T. M., G. M. Ylitalo, S. M. O'Neill, M. E. Dahlheim, P. R. Wade, C. O. Matkin, V. Burkanov, and D. T. Boyd. 2020. Concentrations and profiles of organochlorine contaminants in North Pacific resident and transient killer whale (*Orcinus orca*) populations. Science of The Total Environment 722:137776. https://doi.org/10.1016/j.scitotenv.2020.137776.

Lenz, P. H., and V. Roncalli. 2019. Diapause within the context of life-history strategies in Calanid copepods (Calanoida: Crustacea). The Biological Bulletin 237:170-179. https://doi.org/10.1086/705160.

Lindeberg, M. R., M. Baker, D. M. Dickson, D. G. Kimmel, O. A. Ormseth, and S. L. Strom 2022. Long-term monitoring and integrated research–understanding ecosystem processes in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 206:105208. https://doi.org/10.1016/j.dsr2.2022.105208.

Lindeberg, M. R., J. M. Maselko, R. A. Heintz, M. G. Carls, C. Fugate, and L. G. Holland. 2018. Conditions of persistent oil on beaches in Prince William Sound 26 years after the *Exxon Valdez* spill. Deep-Sea Research Part II: Topical Studies in Oceanography 147:9-19. https://doi.org/10.1016/j.dsr2.2017.07.011.

Litzow, M. A., A. A. Abookire, J. T. Duffy-Anderson, B. J. Laurel, M. J. Malick, and L. A. Rogers. 2022. Predicting year class strength for climate-stressed gadid stocks in the Gulf of Alaska. Fisheries Research 249:106250. https://doi.org/10.1016/j.fishres.2022.106250.

Litzow, M., M. E. Hunsicker, E. J. Ward, S. C. Anderson, J. Gao, S. G. Zador, S. Batten, S. C. Dressel, J. Duffy-Anderson, E. Fergusson, R. Hopcroft, B. J. Laurel, R. O'Malley. 2020. Evaluating ecosystem change as Gulf of Alaska temperature exceeds the limits of preindustrial variability. Progress in Oceanography 186:102393. https://doi.org/10.1016/j.pocean.2020.102393.

Litzow, M. A., M. Malick, N. A. Bond, C. J. Cunningham, J. L. Gosselin, and E. J. Ward. 2020b. Quantifying a novel climate through changes in PDO-climate and PDO-salmon relationships. Geophysical Research Letters 47:e2020GL087972.

McKinstry, C. A. E., and R. W. Campbell. 2018. Seasonal variation of zooplankton abundance and community structure in Prince William Sound, Alaska, 2009-2016. Deep Sea Research Part II: Topical Studies in Oceanography 147:69-78. https://doi.org/10.1016/j.dsr2.2017.08.016.

McKinstry, C. A. E., R. W. Campbell, and K. Holderied. 2022. Influence of the 2014-2016 marine heatwave on seasonal zooplankton community structure and abundance in the lower Cook Inlet, Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 195:105012. https://doi.org/10.1016/j.dsr2.2021.105012.

McGowan, D. W., E. D. Goldstein, M. L. Arimitsu, A. L. Deary, O. Ormseth, A. De Robertis, J. K. Horne, L. A. Rogers, M. T. Wilson, K. O. Coyle, K. Holderied, J. F. Piatt, W. T. Stockhausen, and S. Zador. 2020. Spatial and temporal dynamics of Pacific capelin *Mallotus catervarius* in the Gulf of Alaska: implications for ecosystem-based fisheries management. Marine Ecology Progress Series 637:117–140. https://doi.org/10.3354/meps13211.

Monson, D., R. L. Taylor, G. V. Hilderbrand, J. A. Erlenbach, H. A. Coletti, K. A. Kloecker, G. G. Esslinger, and J. L. Bodkin. 2022. Brown bear–sea otter interactions along the Katmai coast: terrestrial and nearshore communities linked by predation. Journal of Mammalogy 104:171-183. https://doi.org/10.1093/jmammal/gyac095.

Moran, J. R., R. A. Heintz, J. M. Straley, and J. J. Vollenweider. 2017. Regional variation in the intensity of humpback whale predation on Pacific herring in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 147:187-195. https://doi.org/10.1016/j.dsr2.2017.07.010.

Moran, J. R., M. B. O'Dell., D. M. S. Dickson, J. M. Straley, and M. L. Arimitsu. 2018. Seasonal distribution of Dall's porpoise in Prince William Sound, Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 147:173-186. https://doi.org/10.1016/j.dsr2.2017.11.002.

Myers, H. J., D. W. Olsen, C. O. Matkin, L. A. Horstmann, and B. Konar. 2021. Passive acoustic monitoring of killer whales (*Orcinus orca*) reveals year-round distribution and residency patterns in the Gulf of Alaska. Scientific Reports 11:20284. https://doi.org/10.1038/s41598-021-99668-0.

Nielsen, J. M., L. A. Rogers, D. G. Kimmel, A. L. Deary, and J. T. Duffy-Anderson. 2019. Contribution of walleye pollock eggs to the Gulf of Alaska food web in spring. Marine Ecology Progress Series 632:1-12. https://doi.org/10.3354/meps13188.

Olsen, D., C. O. Matkin, R. D. Andrews, and S. Atkinson. 2018. Seasonal and pod-specific differences in core use areas by resident killer whales in the Northern Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 147:196-202. https://doi.org/10.1016/j.dsr2.2017.10.009.

Olsen, D. W., C. O. Matkin, F. J. Mueter, and S. Atkinson. 2020. Social behavior increases in multipod aggregations of southern Alaska resident killer whales (*Orcinus orca*). Marine Mammal Science 36:1150-1159. https://doi.org/10.1111/mms.12715.

Olson, A. P., C. E. Siddon, and G. L. Eckert. 2018. Spatial variability in size at maturity of golden king crab (*Lithodes aequispinus*) and implications for fisheries management. Royal Society Open Science 5. http://doi.org/10.1098/rsos.171802.

Ormseth, O. A., M. M. Baker, R. R. Hopcroft, C. Ladd, C. W. Mordy, J. H. Moss, F. J. Mueter, S. K. Shotwell, and S. L. Strom. 2019. Introduction to understanding ecosystem processes in the Gulf of Alaska, volume 2. Deep Sea Research Part II: Topical Studies in Oceanography 165:1-6. https://doi.org/10.1016/j.dsr2.2019.06.019.

Pearson, S., I. Keren, P. J. Hodum, B. A. Drummond, J. M. Hipfner, N. A. Rojek, H. M. Renner, and S. M. Thomas. 2022. Range-wide changes in the North American Tufted Puffin *Fratercula cirrhata* breeding population over 115 years. Bird Conservation International 33:e24. doi:10.1017/S0959270922000193.

Piatt, J. F., J. K. Parrish, H. M. Renner, S. K. Schoen, T. T. Jones, M. L. Arimitsu, K. J. Kuletz, B. Bodenstein, M. García-Reyes, R. S. Duerr, R. M. Corcoran, R. S. A. Kaler, G. J. McChesney, R. T. Golightly, H. A. Coletti, R. M. Suryan, H. K. Burgess, J. Lindsey, K. Lindquist, P. M. Warzybok, J. Jahncke, J. Roletto, and W. J. Sydeman. 2020. Extreme mortality and reproductive failure of common murres resulting from the northeast Pacific marine heatwave of 2014-2016. PLoS ONE 15:e0226087. https://doi.org/10.1371/journal.pone.0226087.

Pinchuk, A. I., S. D. Batten, and W. W. Strasburger. 2021. Doliolid (Tunicata, Thaliacea) blooms in the southeastern Gulf of Alaska as a result of the recent marine heat wave of 2014 – 2016. Frontiers in Marine Science 8:625486. https://doi.org/10.3389/fmars.2021.625486.

Robinson, C. L. K., D. F. Bertram, H. Shannon, V. R. von Biela, W. Greentree, W. Duguid, and M. L. Arimitsu. *In Revision*. Reduction in overwinter body condition and size of Pacific sand lance has implications for piscivorous marine predators during marine heatwaves. Marine Ecology Progress Series.

Robinson, B. H., H. A. Coletti, L. M. Phillips, and A. N. Powell. 2018. Are prey remains accurate indicators of chick diet? A comparison of diet quantification techniques for Black Oystercatchers. Wader Study 125:20-32. doi:10.18194/ws.00105.

Robinson, B. H., L. M. Phillips, and A. N. Powell. 2019. Energy intake rate influences survival of Black Oystercatcher *Haematopus bachmani* broods. Marine Ornithology 47:277-283.

Roncalli, V., M. C. Cieslak, S. A. Sommer, R. R. Hopcroft, and P. H. Lenz. 2018. De novo transcriptome assembly of the calanoid copepod *Neocalanus flemingeri*: A new resource for emergence from diapause. Marine Genomics 37:114–119. https://doi.org/10.1016/j.margen.2017.09.002.

Roncalli, V., M. C. Cieslak, M. Germano, R. R. Hopcroft, and P. H. Lenz. 2019. Regional heterogeneity impacts gene expression in the subarctic zooplankter *Neocalanus flemingeri* in the northern Gulf of Alaska. Communications Biology 2:1-13. https://doi.org/10.1038/s42003-019-0565-5.

Roncalli, V., M. C. Cieslak, R. R. Hopcroft, and P. H. Lenz. 2020. Capital breeding in a diapausing copepod: A transcriptomics analysis. Frontiers in Marine Science 7. https://doi.org/10.3389/fmars.2020.00056.

Roncalli, V., J. Niestroy, M. C. Cieslak, A. M. Castelfranco, R. R. Hopcroft, and P. H. Lenz. 2022. Physiological acclimatization in high-latitude zooplankton. Molecular Ecology, 31:1753–1765. https://doi.org/10.1111/mec.16354.

Roncalli, V., S. A. Sommer, M. C. Cieslak, C. Clarke, R. R. Hopcroft, and P. H. Lenz. 2018. Physiological characterization of the emergence from diapause: A transcriptomics approach. Scientific Reports 8:12577. https://doi.org/10.1038/s41598-018-30873-0.

Ross, J., N. Kinner, S. Saupe, J. Schloemer, and K. Ziervogel. 2022. Characterization of particle sedimentation in a subarctic estuary: A sediment trap study over two productivity seasons. Estuaries and Coasts 45:2263-2372. https://doi.org/10.1007/s12237-022-01069-7.

Ruesink J. L., P. L. Reynolds, C. Boström. M. Cusson, J. Douglass, J. Eklöf, A. H. Engelen. M. Hori, K. Hovel, K. Iken, P. O. Moksnes, M. Nakaoka, M. I. O'Connor, J. L. Olsen, E. E. Sotka, J. J. Stachowicz, M. A. Whalen, and J. E. Duffy. 2018. Form-function relationships in a marine foundation species depend on scale: a shoot to global

perspective from a distributed ecological experiment. Oikos 127:364-374. https://doi.org/10.1111/oik.04270.

Sánchez-Montes, M. L., E. L. McClymont, J. M. Lloyd, J. Müller, E. A. Cowan, C. Zorzi, and A. de Vernal. 2020. Late Pliocene Cordilleran Ice Sheet development with warm Northeast Pacific sea surface temperatures. Climate of the Past 16:299-313. https://doi.org/10.5194/cp-16-299-2020.

Schaefer, A. L, M. A. Bishop, and R. Thorne. 2020. Marine bird response to forage fish during winter in subarctic bays. Fisheries Oceanography 29:297-308. https://doi.org/10.1111/fog.12472.

Schoen, S., M. Arimitsu, C. Marsteller, and J. Piatt. 2022. Lingering impacts of the 2014-2016 northeast Pacific marine heatwave on seabird demography in Cook Inlet, Alaska. Marine Ecology Progress Series :HEATav1. https://doi.org/10.3354/meps14177.

Siedlecki, S. A., D. J. Pilcher, A. J. Hermann, K. Coyle, and J. Mathis. 2017. The importance of freshwater to spatial variability of aragonite saturation state in the Gulf of Alaska. Journal of Geophysical Research: Oceans 122:8482–8502. https://doi.org/10.1002/2017JC012791.

Siegert, D., B. Konar, M. R. Lindeberg, S. Saupe, and K. Iken. 2022. Trophic structure of rocky intertidal communities in two contrasting high-latitude environments. Deep Sea Research Part II: Topical Studies in Oceanography 198:105050. https://doi.org/10.1016/j.dsr2.2022.105050.

Stocking, J., M. A. Bishop, and A. Arab. 2018. Spatio-temporal distributions of piscivorous birds in a subarctic sound during the non-breeding season. Deep-Sea Research Part II 147:138-147. https://doi.org/10.1016/j.dsr2.2017.07.017.

Straley, J. M., J. R. Moran, K. M. Boswell, R. A. Heintz, T. J. Quinn II, B. Witteveen, and S. D. Rice. 2017. Seasonal presence and potential influence of foraging humpback whales upon Pacific herring wintering in the Gulf of Alaska. Deep Sea Research Part II: Topical Studies in Oceanography 147:173-186. http://dx.doi.org/10.1016/j.dsr2.2017.08.008.

Strom, S. L., K. A. Fredrickson, and K. J. Bright. 2019. Microzooplankton in the coastal Gulf of Alaska: Regional, seasonal and interannual variations. Deep Sea Research Part II: Topical Studies in Oceanography 165:192–202. https://doi.org/10.1016/j.dsr2.2018.07.012.

Suryan, R. M., M. L. Arimitsu, H. A. Coletti, R. R. Hopcroft, M. R. Lindeberg, S. J. Barbeaux, S. D. Batten, W. J. Burt, M. A. Bishop, J. L. Bodkin, R. Brenner, R. W. Campbell, D. A. Cushing, S. L. Danielson, M. W. Dorn, B. Drummond, D. Esler, T. Gelatt, D. H. Hanselman, S. A. Hatch, S. Haught, K. Holderied, K. Iken, D. B. Irons, A. B. Kettle, D.

G. Kimmel, B. Konar, K. J. Kuletz, B. J. Laurel, J. M. Maniscalco, C. Matkin, C. A. E. McKinstry, D. H. Monson, J. R. Moran, D. Olsen, W. A. Palsson, W. S. Pegau, J. F. Piatt, L. A. Rogers, N. A. Rojek, A. Schaefer, I. B. Spies, J. M. Straley, S. L. Strom, K. L. Sweeney, M. Szymkowiak, B. P. Weitzman, E. M. Yasumiishi, and S. G. Zador. 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports 11:1–17. https://doi.org/10.1038/s41598-021-83818-5.

Thompson, S. A., M. García-Reyes, W. J. Sydeman, M. L. Arimitsu, S. A. Hatch, and J. F. Piatt. 2019. Effects of ocean climate on the length and condition of forage fish in the Gulf of Alaska. Fisheries Oceanography 28:658–671. https://doi.org/10.1111/fog.12443.

Thorson, J. T., M. L. Arimitsu, T. Levi, and G. H. Roffler. 2022. Diet analysis using generalized linear models derived from foraging processes using R package *mvtweedie*. Ecology e3637. https://doi.org/10.1002/ecy.3637.

Tinker, M. T, J. L. Bodkin, M. Ben-David, and J. A. Estes. 2017. Marine otters. In, Encyclopedia of Marine Mammals. *In* W. F. Perrin, B. Wursig, J. G. M. Thewissen, and C. R. Crumly, editors. Encyclopedia of Marine Mammals, 3rd Edition. Academic Press.

Tinker, M. T., J. L. Bodkin, L. Bowen, B. Ballachey, G. Bentall, A. Burdin, H. Coletti, G. Esslinger, B. B. Hatfield, M. C. Kenner, K. Kloecker, B. Konar, A. K. Miles, D. H. Monson, M. J. Murray, B. Weitzman, and J. A. Estes. 2021. Sea otter population collapse in southwest Alaska: assessing ecological covariates, consequences, and causal factors. Ecological Monographs 91:e01472. https://doi.org/10.1002/ecm.1472.

Traiger, S. B., J. L. Bodkin, H. A. Coletti, B. Ballachey, T. Dean, D. Esler, K. Iken, B. Konar, M. Lindeberg, D. Monson, B. Robinson, R. M. Suryan, and B. P. Weitzman. 2022. Evidence of increased mussel abundance related to the Pacific marine heatwave and sea star wasting. Marine Ecology 43:e12715. https://doi.org/10.1111/maec.12715.

Turner, J. S., J. L. Pretty, and A. M. P. McDonnell. 2017. Marine particles in the Gulf of Alaska shelf system: Spatial patterns and size distributions from in situ optics. Continental Shelf Research 145:13-20. https://doi.org/10.1016/j.csr.2017.07.002.

Weitzman, B., B. Konar, K. Iken, H. Coletti, D. Monson, R. M. Suryan, T. Dean, D. Hondolero, and M. R. Lindeberg. 2021. Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska. Frontiers in Marine Science 8. https://doi.org/10.3389/fmars.2021.556820.

Vandersea, M. W., S. R. Kibler, P. A. Tester, K. Holderied, D. E. Hondolero, K. Powell, S. Baird, A. Doroff, D. Dugan, and R. W. Litaker. 2018. Environmental factors influencing the distribution and abundance of *Alexandrium catenella* in Kachemak bay and lower cook inlet, Alaska, Harmful Algae 77:81-92. https://doi.org/10.1016/j.hal.2018.06.008.

Vandersea, M., S. Kibler, S. Sant, P. Tester, K. Sullivan, G. Eckert, C. Cammarata, K. Reece, G. Scott, A. Place, K. Holderied, D. Hondolero, and R. Litaker. 2017. qPCR assays for *Alexandrium fundyense* and *A. ostenfeldii* (Dinophyceae) identified from Alaskan waters and a review of species-specific *Alexandrium* molecular assays. Phycologia 56:303-320. https://doi.org/10.2216/16-41.1.

Vandersea, M., P. Tester, K. Holderied, D. Hondolero, S. Kibler, K. Powell, S. Baird, A. Doroff, D. Dugan, A. Meredith, M. Tomlinson, and R. Litaker. 2019. An extraordinary *Karenia mikimotoi* "beer tide" in Kachemak Bay, Alaska. Harmful Algae 101706. https://doi.org/10.1016/j.hal.2019.101706.

von Biela, V. R., M. L. Arimitsu, J. F. Piatt, B. Heflin, S. K. Schoen, J. L. Trowbridge, and C. M. Clawson. 2019. Extreme reduction in nutritional value of a key forage fish during the Pacific marine heatwave of 2014-2016. Marine Ecology Progress Series 613:171–182. https://doi.org/10.3354/meps12891.

Walsh, J. E., R. L. Thoman, U. S. Bhatt, P. A. Bieniek, B. Brettschneider, M. Brubaker, S. Danielson, R. Lader, F. Fetterer, K. Holderied, K. Iken, A. Mahoney, M. McCammon and J. Partain. 2018. The high latitude marine heat wave of 2016 and its impacts on Alaska. Bulletin of the American Meteorological Society 99:S39-S43. https://doi.org/10.1175/BAMS-D-17-0105.1.

Weitzman, B., B. Konar, K. Iken, H. Coletti, D. Monson, R. Suryan, T. Dean, D. Hondolero, and M. Lindeberg. 2021. Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska. Frontiers in Marine Science 8:556820. https://doi.org/10.3389/fmars.2021.556820

Zador, S. G., K. K. Holsman, K. Y. Aydin, and S. K. Gaichas. 2017. Ecosystem considerations in Alaska: the value of qualitative assessments, ICES Journal of Marine Science 74:421-430. https://doi.org/10.1093/icesjms/fsw144.

Zuur A. F., N. Dawson, M. A. Bishop, K. Kuletz, A. A. Saveliev, and E. N. Ieno. 2012. Two-stage GAMM applied to zero inflated common murre density data. Pages 149-182 *in* A. F. Zuur, A. A. Saveliev, and E. N. Ieno, editors. Inflated and generalized linear mixed models with R. Highland Statistics Ltd. Newburgh, UK.

Reports

Arimitsu, M., H. Burgess, R. Corcoran, S. Hatch, T. Jones, J. Lindsey, C. Marsteller, J. Piatt, and S. Schoen. 2020. Pages 121-128 *in* B. E. Ferriss and S. Zador, editors. Gulf of Alaska Ecosystem Status Report 2020. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Arimitsu, M., D. Cushing, B. Drummond, S. Hatch, T. Jones, R. Kaler, E. Labunski, J. Lindsey, J. F. Piatt, H. Renner, and S. Whelan. 2022. Seabird Synthesis. Pages 124-134 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2022: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Arimitsu, M., D. Cushing, B. Drummond, S. Hatch, T. Jones, J. F. Piatt, and H. Renner. 2021. Seabird Synthesis. Pages 152-163 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska, 99501. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Arimitsu, M. L., J. F. Piatt, B. Heflin, V. R. von Biela, and S. K. Schoen. 2018. Monitoring long-term changes in forage fish distribution, abundance and body condition. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-O). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Arimitsu, M. L., J. F. Piatt, and S. Hatch. 2019. Monitoring long-term changes in forage fish distribution, abundance and body condition in Prince William Sound. *Exxon Valdez* Oil Spill Restoration Project Annual Report. U. S. Geological Survey Alaska Science Center, Anchorage, Alaska. February 2019.

Arimitsu, M.L., S. K. Schoen, J. F. Piatt, C. E. Marsteller, B. Heflin, and G. S. Drew. 2019. Status of forage fish and seabirds in lower Cook Inlet during Summer 2018. Progress report to USFWS and BOEM. U. S. Geological Survey Alaska Science Center, Anchorage, Alaska. July 2019.

Arimitsu, M. L., J. F. Piatt, S. Hatch. 2020. Monitoring long-term changes in forage fish distribution, abundance and body condition in Prince William Sound. *Exxon Valdez* Oil Spill Restoration Project Annual Report. U. S. Geological Survey Alaska Science Center, Anchorage, Alaska. February 2020.

Arimitsu, M. L., J. Piatt, S. Hatch, R. Suryan, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Haught, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. W. McGowan, J. Moran, S. Pegau, A. Schaefer, S. Schoen, J. Straley, and V. R. von Biela. 2020. Chapter 3 Reduced quality and synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. *In* R. M. Suryan, M. R. Lindeberg, and D. R. Aderhold, editors. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Draft Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2021/05/GWA_Science_Synthesis_Report_Final_2021.pdf.

Arimitsu, M., S. Schoen, J. Piatt, C. Marsteller, and G. Drew. 2021. Monitoring the recovery of seabirds and forage fish following a major ecosystem disruption in Lower Cook Inlet. Anchorage, Alaska: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-031. 50 p. Anchorage, Alaska: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-031.

Batten, S. 2017. Continuous Plankton Recorder data from the Northeast Pacific: Lower trophic levels in 2016. Pages 80-83 *in* S. Zador and E. M. Yasumiishi. Ecosystem Status Report 2017: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://repository.library.noaa.gov/view/noaa/19465.

Batten, S. 2018. Continuous Plankton Recorder data from the northeast Pacific through 2017. Pages 65-66 *in* S. G. Zador, and E. M. Yasumiishi, editors. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Batten, S. 2018. Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-D. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2018/10/17120114-D_Batten_CPR_Annual_Project_Report-FINAL.pdf.

Batten, S. 2019. Continuous Plankton Recorder data from the Northeast Pacific, 2000-2018. Pages 74-77 *in* S. G. Zador, E. M. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Batten, S. 2019. Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-D. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2019/04/18120114-D-Annual-Report.pdf.

Batten, S. 2020. Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf. FY19 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 19120114-D. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2020/11/19120114-D_Batten_FY19_Annual_Report.pdf.

Batten, S. D., and R. Brown. 2018. Long-term monitoring of plankton populations on the Alaskan shelf and in the Gulf of Alaska using Continuous Plankton Recorders. Long-

Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-A). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2018/08/16120114-A-Batten-et-al.-2018-Final-Report.pdf.

Bentz, S., M. Johnson, G. Gibson, S. Baird, and J. Schloemer. 2018. Ocean Circulation Mapping to Aid Monitoring Programs for Harmful Algal Blooms and Marine Invasive Transport in South-central, Alaska. State Wildlife Grant, Alaska Department of Fish and Game, Annual Report.

Bishop, M. A. 2018. Long-term monitoring of seabird abundance and habitat associations during late fall and winter in Prince William Sound. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-C), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Bishop, M. A., and A. Schaefer. 2021. Long-term monitoring of marine bird abundance and habitat associations during fall and winter in Prince William Sound. FY20 Annual Report to the *Exxon Valdez* oil Spill Trustee Council (Project 20120114-E), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Bishop, M. A., and A. Schaefer. 2020. Long-term monitoring of marine bird abundance and habitat associations during fall and winter in Prince William Sound. FY19 Annual Report to the *Exxon Valdez* oil Spill Trustee Council (Project 19120114-E), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Bishop, M. A., and A. Schaefer. 2019. Long-term monitoring of marine bird abundance and habitat associations during fall and winter in Prince William Sound. FY18 Annual Report to the *Exxon Valdez* oil Spill Trustee Council (Project 18120114-E), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Bishop, M. A., and A. Schaefer. 2018. Long-term monitoring of marine bird abundance and habitat associations during fall and winter in Prince William Sound. FY17 Annual Report to the *Exxon Valdez* oil Spill Trustee Council (Project 17120114-E), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Boldt, J. L., A. Javorski, and P. C. Chandler, eds. 2019. State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2018. Canadian Technical Report of Fisheries and Aquatic Sciences 3314: 248 p. https://waves-vagues.dfo-mpo.gc.ca/Library/4081306x.pdf.

Boldt, J. L., A. Javorski, and P. C. Chandler, eds. 2020. State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2019. Canadian

Technical Report of Fisheries and Aquatic Sciences 3377: 288 p. https://waves-vagues.dfo-mpo.gc.ca/Library/40884569.pdf.

Boldt, J. L., A. Javorski, and P.C. Chandler, eds. 2021. State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2020. Canadian Technical Report of Fisheries and Aquatic Sciences 3434: 231 p. https://waves-vagues.dfo-mpo.gc.ca/Library/4098297x.pdf.

Bowen, L., A. Love, S. Waters, K. Counihan, B. Ballachey, and H. Coletti. 2019. Report: Port Valdez Mussel Transcriptomics. Prepared for Prince William Sound Regional Citizens' Advisory Council. Contract Number 951.20.06.

Campbell, R. W. 2018. Monitoring the Oceanographic Conditions of Prince William Sound. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-G. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Campbell, R. W. 2019. Monitoring the Oceanographic Conditions of Prince William Sound. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-G. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Campbell, R. W. 2020. Monitoring the Oceanographic Conditions of Prince William Sound. FY19 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 19120114-G. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Campbell, R. W. 2021. Monitoring the Oceanographic Conditions of Prince William Sound. FY20 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 20120114-G. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Campbell, R. W. 2022. Temperature trends in the near surface waters of Prince William Sound. Pages 156-158 *in* B. E. Ferriss and S. G. Zador, editors. Ecosystem Status Report 2022: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Campbell, R. W., and C. McKinstry. 2018. Zooplankton trends in Prince William Sound. Pages 67-70 *in* S. G. Zador, and E. M. Yasumiishi, editors. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Campbell, R. W., and C. McKinstry. 2019. Temperature trends in the surface waters of Prince William Sound. Pages 57-58 *in* S. G. Zador, and E. M. Yasumiishi, editors. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management

Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Campbell, R. W., and C. McKinstry. 2019. Temperature trends in the surface waters of Prince William Sound. Pages 62-63 *in* S. G. Zador, E. M. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Campbell, R. W., and C. McKinstry. 2019. Zooplankton trends in Prince William Sound. Pages 85-87 S. G. Zador, E. M. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Campbell, R. W., and C. McKinstry. 2021. Temperature trends in the near surface waters of Prince William Sound. Pages 195-196 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Coletti, H., J. Bodkin, T. Dean, D. Esler, K. Iken, B. Ballachey, K. Kloecker, B. Konar, M. Lindeberg, D. Monson, B. Robinson, R. Suryan and B. Weitzman. 2019. Intertidal Ecosystem Indicators in the Northern Gulf of Alaska. Pages 67-72 *in* S. G. Zador, E. M. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Coletti, H., J. Bodkin, T. Dean, D. Esler, K. Iken, B. Ballachey, K. Kloecker, B. Konar, M. Lindeberg, D. Monson, B. Robinson, R. Suryan and B. Weitzman. 2020. Intertidal Ecosystem Indicators in the Northern Gulf of Alaska. Pages 56-58 *in* B. Ferriss, and S. G. Zador, editors. 2020. Ecosystem Status Report 2020: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Coletti, H., J. Bodkin, T. Dean, K. Iken, B. Konar, D. Monson, D. Esler, M. Lindeberg, R. Suryan. 2018. Intertidal Ecosystem Indicators in the Northern Gulf of Alaska. Pages 61-64 *in* S. G. Zador, and E. M. Yasumiishi, editors. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Coletti, H., J. Bodkin, T. Dean, K. Iken, B. Konar, D. Monson, D. Esler, M. Lindeberg, and R. Suryan. 2021. Intertidal Ecosystem Indicators in the Northern Gulf of Alaska. Pages 197-201 *in* B. E. Ferriss and S. Zador, editors. 2021. Ecosystem Status Report 2021: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Coletti, H., J. Bodkin, T. Dean, K. Iken, B. Konar, D. Monson, D. Esler, M. Lindeberg, and R. Suryan. 2022. Intertidal ecosystem indicators in the northern Gulf of Alaska. Pages 159-163 *in* B. E. Ferriss and S. G. Zador, editors. Ecosystem Status Report 2022: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Coletti, H., D. Esler, B. Ballachey, J. Bodkin, G. Esslinger, K. Kloecker, D. Monson, B. Robinson, B. Weitzman, T. Dean, and M. Lindeberg. 2018. Gulf Watch Alaska: Nearshore Benthic Systems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-R), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H., D. Esler, B. Konar, K. Iken, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, K. Kloecker, M. Lindeberg, D. Monson, B. Robinson, S. Traiger, and B. Weitzman. 2022. Gulf Watch Alaska: Nearshore ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project 2021 Annual Report (Restoration Project 17120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H., D. Esler, B. Konar, K. Iken, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, B. Robinson, and M. Lindeberg. 2018. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 17120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H., D. Esler, B. Konar, K. Iken, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, K. Kloecker, M. Lindeberg, D. Monson, B. Robinson, S. Traiger and B. Weitzman. 2021. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project 2020 Annual Report (Restoration Project 17120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H., D. Esler, B. Konar, K. Iken, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, B. Robinson, and M. Lindeberg. 2019. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 18120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H., D. Esler, B. Konar, K. Iken, K. Kloecker, D. Monson, B. Weitzman, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, B. Robinson, and M. Lindeberg. 2019. Gulf Watch Alaska: Nearshore Ecosystems in the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 18120114-H), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Coletti, H. A., and T. L. Wilson. 2018. Nearshore marine bird surveys: Data synthesis, analysis and recommendations for sampling frequency and intensity to detect population trends. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 12120114-F). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Danielson, S. 2018. Temperature and salinity at GAK1. Pages 74-75 *in* S. Zador and E. M. Yasumiishi. Ecosystem Status Report 2017: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://repository.library.noaa.gov/view/noaa/19465.

Danielson, S. 2019. Oceanographic station GAK1 water column conditions. Pages 60-61 *in* S. Zador, E. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Danielson, S. L. 2020. Oceanographic station GAK-1 water column conditions. Pages 47-48 *in* B. E. Ferriss and S. Zador, editors. Gulf of Alaska Ecosystem Status Report 2020. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Danielson, S. L. 2023. Glacier Bay Oceanographic Monitoring Program Analysis of Observations, 1993-2016. Natural Resource Technical Report. National Park Service, Fort Collins, Colorado.

Danielson, S. L., T. D. Hennon, D. H. Monson, R. M. Suryan, R. W. Campbell, S. J. Baird, K. Holderied, and T. J. Weingartner. 2020. Chapter 1 A study of marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. In R. M. Suryan, M. R. Lindeberg, and D. R. Aderhold, eds. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 20120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2021/05/GWA_Science_Synthesis_Report_Final_2021.pdf.

Danielson, S. L., and R. R. Hopcroft. 2018. Seward line May temperatures. Pages 55-57 *in* S. G. Zador and E. M. Yasumiishi, editors. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Danielson, S. L., and R. R. Hopcroft. 2020. Seward Line May Temperatures. Pages 45-46 *in* B. Ferriss and S. Zador, editors. Gulf of Alaska Ecosystem Status Report 2020. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Danielson, S. L, and T. J. Weingartner. 2018. Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK1. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-I. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Danielson, S. L, and T. J. Weingartner. 2019. Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK1. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-I. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Danielson, S. L, and T. J. Weingartner. 2020. Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK1. FY19 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 19120114-I. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Danielson, S. L, and T. J. Weingartner. 2021. Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK1. FY20 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 20120114-I. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Doroff, A., and K. Holderied. 2018. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay to understand recovery and restoration of injured near-shore species. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-G), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Doroff, A., M. Johnson, and G. Gibson. 2017. Ocean Circulation Mapping to Aid Monitoring Programs for Harmful Algal Blooms and Marine Invasive Transport in South-central, Alaska. State Wildlife Grant, Alaska Department of Fish and Game, Annual Report.

Du, X., R. Campbell, S. Kibler, B. Wright, K. Holderied, D. Hondolero, R. Masui, M. Arimitsu, J. Piatt, and F. Matweyou. 2022. Prevalence of Paralytic Shellfish Toxins in the Marine

Food Webs of Prince William Sound and Kachemak Bay, Alaska. Final Report, North Pacific Research Board Project 1801.

Dugan, D., R. Masui, G. Eckert, K. Holderied, A. Wall, K. Lanphier, C. Poe, G. Sheffield, K. Lefebvre, and D. Anderson. 2020. Disease and toxins indicators: Harmful algal blooms in the Gulf of Alaska. Pages 149-153 *in* B. Ferriss and S. Zador, editors. Gulf of Alaska Ecosystem Status Report 2020. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301.

Farrugia, T., D. Dugan, R. Masui, D. Hondolero, G. Ellwanger, A. Jarosz, S. Kibler, K. Lanphier, C. Poe, N. Rouse, C. Hart, B. Wright, and S. Schoen. 2021. Disease and toxins indicators: Harmful algal blooms in the Gulf of Alaska. Pages 189-193 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska.

Ferriss, B. E., and S. Zador, eds. 2020. Ecosystem Status Report 2020: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Ferriss, B. E., and S. Zador, eds. 2021. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Ferriss, B. E., and S. Zador, eds. 2022. Ecosystem Status Report 2022: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Esslinger, G. G., B. H. Robinson, D. H. Monson, R. L. Taylor, D. Esler, B. P. Weitzman, and J. Garlich-Miller. 2021. Abundance and distribution of sea otters (*Enhydra lutris*) in the Southcentral Alaska stock, 2014, 2017 and 2019. U.S. Geological Survey Open-File Report 2021–1122, 19p. https://doi.org/10.3133/ofr20211122.

Garlich-Miller, J., G. Esslinger, and B. Weitzman. 2018. Aerial surveys of sea otters (*Enhydra lutris*) in lower Cook Inlet, Alaska, May 2017. USFWS Technical Report MMM 2018-01. U.S. Fish & Wildlife Service, Marine Mammals Management. Anchorage, Alaska

Green, D., C. Rankin, L. Ware, D. Esler, B. Robinson, and H. Coletti. 2022. Movement ecology of Black Oystercatchers. Alaska Shorebird Group Annual summary compilation: new and

ongoing studies or initiatives focused on Alaska shorebirds. Alaska Shorebird Group, Anchorage, Alaska.

Hatch, S. A., M. Arimitsu, and J. F. Piatt. 2017. Seabird-derived forage fish indicators from Middleton Island. Pages 112-115 *in* S. Zador and E. M. Yasumiishi. Ecosystem Status Report 2017: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://repository.library.noaa.gov/view/noaa/19465.

Hatch, S. A., M. Arimitsu, and J. F. Piatt. 2018. Seabird-derived forage fish indicators from Middleton Island. Pages 77-81 *in* S. G. Zador and E. M. Yasumiishi, editors. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Hatch, S. A., M. Arimitsu, and J. F. Piatt. 2019. Seabird-derived forage fish indicators from Middleton Island. Pages 105-108 *in* S. Zador, E. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Hatch, S. A., M. Arimitsu, and J. F. Piatt. 2020. Seabird-derived forage fish indicators from Middleton Island. Pages 77-81 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska, 99501. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Hatch, S. A., M. Arimitsu, and J. F. Piatt. 2021. Seabird-derived forage fish indicators from Middleton Island. Pages 94-96 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska, 99501. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Hatch, S. A., M. Arimitsu, and J. F. Piatt. 2022. Seabird-derived forage fish indicators from Middleton Island. Pages 86-88 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2022: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Hoffman, K. 2017. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Standardized Interim Progress Report, award number NA17NMF4720018 to National Oceanic and Atmospheric Administration. August.

Hoffman, K. 2018. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Standardized Interim Progress Report, award number NA17NMF4720018 to National Oceanic and Atmospheric Administration. March.

Hoffman, K. 2018. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Standardized Interim Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. August.

Hoffman, K. 2019. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. March.

Hoffman, K. 2019. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. August.

Hoffman, K. 2020. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. March.

Hoffman, K. 2020. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. August.

Hoffman, K. 2021. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. March.

Hoffman, K. 2021. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. August.

Hoffman, K. 2022. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management

programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. March.

Hoffman, K. 2022. Research and monitoring programs in the *Exxon Valdez* oil spill affected waters: Long-term monitoring; herring research and monitoring; and data management programs. Department of Commerce Research Performance Progress Report, award number NA17NMF4720018. National Oceanic and Atmospheric Administration. August.

Hoffman, K. C., and M. E. McCammon. 2018. Long term monitoring: program coordination and logistics & outreach. *Exxon Valdez* Oil Spill Trustee Council Restoration Project Final Report (Restoration Project 16120014-B). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Holderied, K., and D. Aderhold. 2018. Science coordination and synthesis for the long-term monitoring program. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-H). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska

Holderied, K., S. Baird, J. Schloemer, D. Hondolero, B. Weitzman, M. Renner, and C. Guo. 2021. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay. FY20 annual report to the *Exxon Valdez* Oil Spill Trustee Council, Project 20120114-J. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska

Holderied, K., S. Baird, J. Schloemer, and D. Hondolero. 2020. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay. FY19 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 19120114-J. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska

Holderied, K., S. Baird, K. Powell Schuster, J. Schloemer, and D. Hondolero. 2019. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-J. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska

Holderied, K., M. Renner, C. Guo, D. Hondolero, J. Schloemer, S. Baird, and C. Walker. 2023. Long-term monitoring of oceanographic conditions in Cook Inlet/ Kachemak Bay. *Exxon Valdez* Oil Spill Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-J), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Holderied, K., and J. Shepherd. 2018. Long-term monitoring of oceanographic conditions in Cook Inlet/Kachemak Bay to understand recovery and restoration of injured near-shore species. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-J. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska

Hopcroft, R. R. 2019. Spring and fall large copepod and euphausiid biomass along the Seward Line. Pages 83-84 *in* S. Zador, E. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Hopcroft, R. R. 2020. Spring and fall large copepod and euphausiid biomass along the Seward Line. Pages 68-69 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2020: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Hopcroft, R. R. 2021. Spring and fall large copepod and euphausiid biomass: Seward Line. Pages 76-77 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Hopcroft, R. R. 2022. Spring and fall large copepod and euphausiid biomass: Seward Line. Pages 70-71 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2022: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Hopcroft, R. R., and K. O. Coyle. 2018. May large copepod and euphausiid biomass along the Seward Line. Pages 66-67 57 *in* S. G. Zador and E. M. Yasumiishi, editors. 2018. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Jones, T., S. Saupe, K. Iken, B. Konar, S. Venator, M. Lindeberg, H. Coletti, B. Pister, J. Reynolds, and K. Haven. 2019. Evaluation of nearshore communities and habitats: Lower Cook Inlet nearshore ecosystem. Anchorage (Alaska): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-075. 219 p.

Kaler, R. S. A., D. A. Cushing, E. Labunski, and K. Kuletz. 2023. Prince William Sound and Gulf of Alaska Marine Bird Surveys. *Exxon Valdez* Oil Spill Restoration Project Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 21120114-M), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Kaler, R., E. Labunski, and K. J. Kuletz. 2017. Prince William Sound Marine Bird Surveys. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-K), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Konar B., K. Iken, and A. Doroff. 2018. Long-term monitoring: nearshore benthic ecosystems in Kachemak Bay. Long-term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-L). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Lindeberg, M., and K. Hoffman. 2018. Program management I—Program coordination and science synthesis and program management II—Administration, science review panel, PI meeting logistics, outreach, and community involvement. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, Projects 17120114-A and B. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska

Lindeberg, M., and K. Hoffman. 2019. Program Management I – Program coordination and science synthesis and Program Management II – Administration, science review panel, PI meeting logistics, outreach, and community involvement. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Annual Report (*Exxon Valdez* Oil Spill Trustee Council Project: 18120114-A and B), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Lindeberg, M., and K. Hoffman. 2020. Program Management I – Program coordination and science synthesis and Program Management II – Administration, science review panel, PI meeting logistics, outreach, and community involvement. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Annual Report (*Exxon Valdez* Oil Spill Trustee Council Project: 19120114-A and B), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Lindeberg, M., and K. Hoffman. 2021. Program Management I – Program coordination and science synthesis and Program Management II – Administration, science review panel, PI meeting logistics, outreach, and community involvement. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Annual Report (*Exxon Valdez* Oil Spill Trustee Council Project: 20120114-A and B), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C.O. and D. W. Olsen. 2018. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. FY17 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 17120114-N. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C. O. and D. W. Olsen. 2019. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18120114-N. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C. O. and D. W. Olsen. 2020. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. FY19 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 19120114-N. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C.O. and D. W. Olsen. 2021. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. FY20 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 20120114-N. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Matkin, C. O., D. W. Olsen, G. Ellis, G. Ylitalo, and R. Andrews 2017. Long-term killer whale monitoring in Prince William Sound/ Kenai Fjords. Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project 16120114-M). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Moran, J. R., and J. M. Straley. 2018. Long-term monitoring of humpback whale predation on Pacific herring in Prince William Sound. *Exxon Valdez* Oil Spill Long-Term Monitoring Program (Gulf Watch Alaska) Final Report (*Exxon Valdez* Oil Spill Trustee Council Project: 16120114-N), *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Moran, J., and J. Straley. 2018. Summer survey of population level indices for Southeast Alaska humpback whales and fall surveys of humpback whales in Prince William Sound. Pages 107-108 *in* S. G. Zador and E. M. Yasumiishi, editors. Ecosystem Status Report 2018: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Moran, J., and J. Straley. 2019. Fall surveys of humpback whales in Prince William Sound. Pages 143-144 *in* S. Zador, E. Yasumiishi, and G. A. Whitehouse, editors. Ecosystem Status Report 2019. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Moran, J., and J. Straley. 2020. Fall surveys of humpback whales in Prince William Sound. Pages 129-130 *in* B. Ferriss and S. G. Zador, editors. Ecosystem Status Report 2020: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99501. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Moran, J., and J. Straley. 2021. Fall surveys of humpback whales in Prince William Sound. Pages 206-207 *in* B. E. Ferriss and S. G. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99501.

Moran, J., and J. Straley. 2022. Fall surveys of humpback whales in Prince William Sound. Pages 167-168 *in* B. E. Ferriss and S. G. Zador, editors Ecosystem Status Report 2022: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99501. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Ostle, C., and S. Batten. 2020. Continuous Plankton Recorder data from the northeast Pacific. Pages 63-65 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2020: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/REFM/docs/2020/GOAecosys.pdf.

Ostle, C., and S. Batten. 2021. Continuous Plankton Recorder monitoring of plankton populations on the Alaskan Shelf. FY20 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 20120114-D. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Ostle, C., and S. Batten. 2021. Continuous Plankton Recorder data from the northeast Pacific. Pages 68-69 *in* B. E. Ferriss and S. Zador, editors. Ecosystem Status Report 2021: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99301. https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAecosys.pdf.

Ostle, C., and S. Batten. 2022. Continuous Plankton Recorder data from the northeast Pacific. Pages 62-63 *in* B. E. Ferriss and S. G. Zador, editors. Ecosystem Status Report 2022: Gulf of Alaska. Report to the North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska 99501. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2022-gulf-alaska.

Rider, M., D. A. Apeti, A., Jacob, K. Kimbrough, E. Davenport, M. Bower, H. Coletti, and D. Esler. 2020. A Synthesis of Ten Years of Chemical Contaminants Monitoring in National Park Service - Southeast and Southwest Alaska Networks. A collaboration with the NOAA National Mussel Watch Program. NOAA Technical Memorandum NOS NCCOS 277. Silver Spring, Maryland. https://repository.library.noaa.gov/view/noaa/25520.

Robinson, B., D. Esler, and H. Coletti. 2019. Long-term monitoring of Black Oystercatchers in the Gulf of Alaska. Annual Summary Compilation: New or ongoing studies of Alaska shorebirds. Alaska Shorebird Group, Anchorage, Alaska.

Robinson, B., D. Esler, and H. Coletti. 2021. Long-term monitoring of Black Oystercatchers in the Gulf of Alaska. 2021. Annual Summary Compilation: New or ongoing studies of Alaska shorebirds. Alaska Shorebird Group Annual Summary. Alaska Shorebird Group, Anchorage, Alaska.

Robinson, B., D. Esler, and H. Coletti. 2022. Long-term monitoring of Black Oystercatchers in the Gulf of Alaska. in Alaska Shorebird Group. Annual summary compilation: new and ongoing studies or initiatives focused on Alaska shorebirds. Alaska Shorebird Group, Anchorage, Alaska.

Schaefer, A. L., and M. A. Bishop. 2021. Winter marine bird surveys in Prince William Sound. Final Report to the Prince William Sound Regional Citizens' Advisory Council (Contract 9110.21.01), Prince William Sound Science Center, Cordova, Alaska.

Schaefer, A. L., and M. A. Bishop. 2022. Marine bird winter surveys in Prince William Sound. Final Report to the Prince William Sound Regional Citizens' Advisory Council (Contract 9110.22.01), Prince William Sound Science Center, Cordova, Alaska.

Starcevich, L. A. H., T. McDonald, A. Chung-MacCoubrey, A. Heard, J. C. B. Nesmith, H. Coletti, and T. Philippi. 2018. Methods for estimating trend in binary and count response variables from complex survey designs. Natural Resource Report NPS/KLMN/NRR—2018/1641. National Park Service, Fort Collins, Colorado. https://irma.nps.gov/DataStore/Reference/Profile/2253180.

Suryan, R. M., M. Arimitsu, H. Coletti, R. R. Hopcroft, M. R. Lindeberg, S. Batten, M. A. Bishop, R. Brenner, R. Campbell, D. Cushing, S. Danielson, D. Esler, T. Gelatt, S. Hatch, S. Haught, K. Holderied, K. Iken, D. Irons, D. Kimmel, B. Konar, K. Kuletz, B. Laurel, J. M. Maniscalco, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, S. Pegau, J. Piatt, L. Rogers, A. Schaefer, J. Straley, K. Sweeney, M. Szymkowiak, B. Weitzman, J. Bodkin, and S. Zador. 2020. Chapter 4 Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska. *In* R. M. Suryan, M. R. Lindeberg, and D. R. Aderhold, editors. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. http://gulfwatchalaska.org/wp-content/uploads/2021/05/GWA_Science_Synthesis_Report_Final_2021.pdf.

Suryan, R. M., M. R. Lindeberg, and D. R. Aderhold, eds. 2019. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Draft Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Ware, L., D. Green, D. Esler, B. Robinson, H. Coletti. 2019 Field Report: Movement Ecology of the Black Oystercatcher in Alaska. Prepared for the Bird Banding Laboratory, Laurel, Maryland.

Ware, L., D. Green, D. Esler, B. Robinson, H. Coletti. 2019. Field Report: Movement Ecology of the Black Oystercatcher in Alaska. Annual Summary Compilation: New or ongoing studies of Alaska shorebirds. Alaska Shorebird Group, Anchorage, Alaska.

Weingartner, T. J., and S. L. Danielson. 2018. Long-term monitoring of oceanographic conditions in the Alaska Coastal Current from hydrographic station GAK1 over 1970-

2016. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 16120114-P). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Weitzman, B., B. Konar, K. Iken, H. Coletti, D. Monson, R. M. Suryan, T. Dean, D. Hondolero, and M. R. Lindeberg. 2020. Chapter 2 Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska. *In* R. M. Suryan, M. R. Lindeberg, and D.R. Aderhold, eds. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Weitzman, B. P., J. L. Bodkin, K. A. Kloecker, and H. A. Coletti. 2017. SOP for monitoring intertidal bivalves on mixed-sediment beaches — version 2.0: Southwest Alaska Inventory and Monitoring Network. Natural Resource Report NPS/SWAN/NRR—2017/1443. National Park Service, Fort Collins, Colorado.

Zador, S, and E. M. Yasumiishi. 2017. Ecosystem Status Report 2017: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://repository.library.noaa.gov/view/noaa/19465.

Zador, S, and E. Yasumiishi. 2018. Ecosystem Status Report 2018: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://apps-afsc.fisheries.noaa.gov/REFM/Docs/2018/GOA/ecosysGOA.pdf.

Zador, S, E. Yasumiishi, and G. A. Whitehouse. 2019. Ecosystem Status Report 2019: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. https://apps-afsc.fisheries.noaa.gov/REFM/REEM/ecoweb/pdf/archive/2019GOAecosys.pdf.

Publicly available datasets

Arimitsu, M. L., B. Heflin, J. F. Piatt, K. A. Hobson, and E. W. Hood. 2017. Biogeochemical Subsidies from Glacier Runoff into Alaska Coastal Marine Food Webs, Gulf of Alaska, 2012-2013: U.S. Geological Survey data release. https://doi.org/10.5066/F7Z036D9.

Arimitsu, M. L., J. F. Piatt, and B. Heflin. 2017. Influence of glacier runoff on ecosystem structure in Gulf of Alaska fjords, 2004-2011: U.S. Geological Survey data release. https://dx.doi.org/10.5066/F7K072DR.

Arimitsu, M. L., J. F. Piatt, B. Heflin, and C. E. Marsteller. 2017. Gulf Watch Alaska - Pelagic Ecosystems Forage Fish Component - data from Prince William Sound: distribution,

abundance, and morphology of fish, zooplankton, and predators and oceanographic Conditions (ver. 2.0, February 2021): U.S. Geological Survey data release. https://doi.org/10.5066/F74J0C9Z.

Arimitsu, M. L., S. K. Schoen, J. F. Piatt, and C. E. Marsteller. 2021. Assessing the status and trends of seabirds and forage fish in lower Cook Inlet, Alaska (ver 1.1, June 2021): U.S. Geological Survey data release. https://doi.org/10.5066/P961LWWE.

Baird, S., C. Guo, and J. Schloemer. 2023. Oceanographic Monitoring in Cook Inlet and Kachemak Bay, Water Quality, Meteorological, and Nutrient Data collected by the National Estuarine Research Reserve System's System-wide Monitoring Program (NERRS SWMP), 2012-2021, Gulf Watch Alaska Environmental Drivers Component. Research Workspace. https://doi.org/10.24431/rw1k21f, version: 10.24431_rw1k21f_20230307T230236Z.

Batten, S. 2017. Continuous Plankton Recorder and Temperature Data, Gulf of Alaska, 2011-2016, Gulf Watch Alaska Environmental Drivers Component. Research Workspace. 10.24431/rw1k21a, version: 1156722c-45bc-4c4e-a33a-6998c2ab84d5. https://search.dataone.org/view/10.24431/rw1k21a

Bishop, M. A., A. Schaefer, K. Kuletz, M. McCammon, and K. Hoffman. 2017. Fall and Winter Seabird Abundance Data, Prince William Sound, 2007-2017, Gulf Watch Alaska Pelagic Component. Research Workspace. 10.24431/rw1k1w. https://search.dataone.org/view/10.24431%2Frw1k1w.

Bishop, M. A., and A. Schaefer. 2022. Fall and winter seabird abundance data, Prince William Sound, 2007-2022, Gulf Watch Alaska pelagic component. Gulf of Alaska Data Portal. https://gulf-of-alaska.portal.aoos.org/#metadata/771492cd-94b6-47ab-952a-02b152a535cf/project/folder_metadata/1766253.

Campbell, R. W. 2022. Oceanographic conditions in Prince William Sound, CTD, chlorophyll-a, and zooplankton data: 2013-2021, Gulf Watch Alaska Environmental Drivers Component. Research Workspace. 10.24431/rw1k19. https://search.dataone.org/view/10.24431%2Frw1k19.

Campbell, R. W. 2022. Environmental drivers: Oceanographic conditions in Prince William Sound. Gulf of Alaska Data Portal. https://gulf-of-alaska.portal.aoos.org/#metadata/fc5b0956-ef7c-49df-b261-c8e2713887fc/project.

Danielson, S. L. 2020. Temperature and salinity time series measurements from the GAK1 Mooring in the Northern Gulf of Alaska near Seward, Alaska, 2017-2019, NGA LTER. Research Workspace. doi:10.24431/rw1k44x, version: 10.24431_rw1k44x_20210511T210557Z.

Danielson, S. L. 2021. CTD profile time series data from the GAK-1 site in the Northern Gulf of Alaska, 1970-2020 (Data One Gulf Watch Environmental Drivers Component). 10.24431/rw1k595, version: 10.24431_rw1k595_20210618T011621Z.

Danielson, S. L. 2022. GAK-1 home page and data archive, University of Alaska Fairbanks. http://research.cfos.uaf.edu/gak1/.

Danielson, S. L. 2022. GAK-1 mooring data via the Alaska Ocean Observing System Gulf of Alaska data portal. https://portal.aoos.org/#metadata/103522/station/data.

Danielson, S. L. 2022. GAK-1 aggregate dataset via the Northern Gulf of Alaska Long Term Ecological Research project homepage. https://nga.lternet.edu/data-overview/signature-datasets/.

Danielson, S. L., and T. J. Weingartner. 2021. Temperature and Salinity Timeseries data from the GAK1 Mooring, Seward, Alaska, 1998-2017 (Data One Gulf Watch Alaska Environmental Drivers Component). Research Workspace. doi:10.24431/rw1k32q, version: 10.24431_rw1k32q_20210303T210210Z.

Drew, G. S., S. K. Schoen, M. D. Hood, M. L. Arimitsu, and J. Piatt. 2023. PWS fall and winter 2007-2021 seabird observations. Bishop, M. A., and A. Schaefer contribution to North Pacific Pelagic Seabird Database (NPPSD) v. 4.0, January 2023: U.S. Geological Survey data release.

Holderied, K. and M. Renner. 2023. Oceanographic Monitoring in Cook Inlet and Kachemak Bay, CTD Data, 2012-2022, Gulf Watch Alaska Environmental Drivers Component. Research Workspace. 10.24431/rw1k32v, version: 10.24431_rw1k32v_20230307T202919Z.

Holderied, K., C. McKinstry, C., and J. Schloemer. 2023. Oceanographic Monitoring in Cook Inlet and Kachemak Bay, Zooplankton Data, 2012-2019, Gulf Watch Alaska Environmental Drivers Component. Research Workspace. 10.24431/rw1k21g, version: 10.24431_rw1k21g_20230307T214302Z.

Iken, K., and B. Konar. Long-term Monitoring of Ecological Communities in Kachemak Bay, 2012-2022, Gulf Watch Alaska Nearshore Component. Research Workspace. 10.24431/rw1k6cw, version: 10.24431_rw1k6cw_20221222T212743Z.

Kaler, R., and K. Kuletz. 2023. Prince William Sound Marine Bird Surveys, July 2012 to 2018, Gulf Watch Alaska Pelagic Component. Research Workspace. 10.24431/rw1k21k, version: 10.24431_rw1k21k_20230307T231301Z.

Kuletz, K., D. Cushing, and E. Labunski. 2020. Marine bird survey observation and density data from Northern Gulf of Alaska LTER cruises, 2018–2020. Research Workspace. Dataset. doi:10.24431/rw1k45w.

Kuletz, K. 2020. Seward Line and Lower Cook Inlet marine bird survey data, 2006–2017, Gulf Watch Alaska Pelagic Component. Research Workspace. Dataset. doi: 10.24431/rw1k21l, version: 10.24431_rw1k21l_2020_6_17_201714.

Kuletz, K., D. Cushing, and E. Labunski. 2020. Marine bird survey observation and density data from Northern Gulf of Alaska LTER cruises, 2018–2020. Research Workspace. Dataset. doi:10.24431/rw1k45w.

Kuletz, K. 2020. Seward Line and Lower Cook Inlet marine bird survey data, 2006–2017, Gulf Watch Alaska Pelagic Component. Research Workspace. Dataset. doi: 10.24431/rw1k21l, version: 10.24431_rw1k21l_2020_6_17_201714.

Lindeberg, M. 2023. Lingering oil: Tracking of oil levels and weathering. Gulf of Alaska Data Portal https://gulf-of-alaska.portal.aoos.org/#metadata/91b73240-b68d-43d8-bd64-aea4ea14e976/project.

LTER Data Portal: https://search.dataone.org/portals/NGALTER/About-the-Data-Catalog.

Matkin, C., and D. Olsen. 2022. Pelagic: Long-term killer whale monitoring. Gulf of Alaska Data Portal. https://gulf-of-alaska.portal.aoos.org/#metadata/2f42dd1c-d67a-4c49-8c2e-1d63387e0ad0/project.

Moran, J. 2022. Pelagic: Humpback whale predation on herring. Gulf of Alaska data portal. https://gulf-of-alaska.portal.aoos.org/#metadata/54adceab-74cb-4419-b02c-bacb6d2acb8b/project.

Moran, J., and J. Straley. 2022. CastAway CTD Data: 2017-2019 and 2021, Gulf Watch Alaska Pelagic Component, Long-term Monitoring of Humpback Whale Predation on Pacific Herring in Prince William Sound. Research Workspace. 10.24431/rw1k7cx, version: 10.24431_rw1k7cx_20230106T063806Z.

Myers, H. 2022. Passive acoustic monitoring of killer whales in the northern Gulf of Alaska. Ocean Biodiversity Information System, Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP). https://seamap.env.duke.edu/dataset/2158.

Ostle, C., and S. Batten. 2022. Continuous Plankton Recorder and Physical Data, Gulf of Alaska, 2017-2020, Gulf Watch Alaska Environmental Drivers Component. Gulf of Alaska Data Portal. https://gulf-of-alaska.portal.aoos.org/#metadata/87f56b09-2c7d-4373-944e-94de748b6d4b/project/folder_metadata/2638347.

Piatt, J. F., M. L. Kissling, M. L Arimitsu, and D. C. Douglas. 2021. Tracking data for Kittlitz's murrelet (*Brachyramphus brevirostris*) (ver 1.0, June 2021): U.S. Geological Survey data release. https://doi.org/10.5066/P9MMVP9I.

Schoen, S.K., J. F. Piatt, and M. L. Arimitsu. 2020. Data from Common Murre die-off surveys and necropsies following the north Pacific marine heatwave, 2015-2016: U.S. Geological Survey data release. https://doi.org/10.5066/P9E8RE9I.

Straley, J., and J. Moran. 2022. Dall's and Harbor Porpoise Survey Data, Prince William Sound, Alaska: 2007-2008, 2011-2015, and 2017-2021, Gulf Watch Alaska Pelagic Component. Research Workspace. 10.24431/rw1k32w, version: 10.24431_rw1k32w_20230106T063353Z.

Straley, J., and J. Moran. 2022. Lipid Analyses for Pacific Herring, Invertebrates and Humpback Whales in the Gulf of Alaska, 2012-2021, Gulf Watch Alaska Pelagic Component. urn:node:RW. 10.24431/rw1k32d, version: 10.24431_rw1k32d_20230106T063258Z.

Straley, J., and J. Moran. 2022. Significance of Whale Predation On Natural Mortality Rate of Pacific Herring in Prince William Sound, Alaska: 2006 - 2009, 2011-2015, Gulf Watch Alaska Pelagic Component. Research Workspace. 10.24431/rw1k7cy, version: 10.24431_rw1k7cy_20230109T035158Z.

Straley, J. and J. Moran. 2022. Dall's and harbor porpoise survey data, Prince William Sound, Alaska: 2007-2008, 2011-2015, and 2017-2021, Gulf Watch Alaska pelagic component. Gulf of Alaska data portal. https://gulf-of-alaska.portal.aoos.org/#metadata/54adceab-74cb-4419-b02c-bacb6d2acb8b/project/folder_metadata/2514142.

Straley, J. and J. Moran. 2022. Lipid analyses for Pacific herring, invertebrates and humpback whales in the Gulf of Alaska, 2012-2021, Gulf Watch Alaska pelagic component. Gulf of Alaska data portal. https://gulf-of-alaska.portal.aoos.org/#metadata/54adceab-74cb-4419-b02c-bacb6d2acb8b/project/folder_metadata/2510153.

Straley, J. and J. Moran. 2022. Significance of whale predation on natural mortality rate of Pacific herring in Prince William Sound, Alaska: 2006-2009, 2011-2015, 2017-2022, Gulf Watch Alaska pelagic component. Gulf of Alaska data portal. https://gulf-of-alaska.portal.aoos.org/#metadata/54adceab-74cb-4419-b02c-bacb6d2acb8b/project/folder_metadata/41873807.

U.S. Geological Survey - Alaska Science Center, National Park Service - Southwest Alaska Inventory and Monitoring Network, 2016. Intertidal mussel (Mytilus) data from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park (ver

3.0, September 2022): U.S. Geological Survey data release, https://doi.org/10.5066/F7FN1498.

U.S. Geological Survey - Alaska Science Center, National Park Service - Southwest Alaska Inventory and Monitoring Network, 2022, Rocky intertidal data from Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park (ver 1.0, September 2022): U.S. Geological Survey data release, https://doi.org/10.5066/F7513WCB.

U.S. Geological Survey Alaska Science Center, National Park Service Southwest Alaska Inventory and Monitoring Network, University of Alaska Fairbanks, 2022. Sea otter spraint data from Kachemak Bay, Katmai National Park and Preserve, Kenai Fjords National Park and Prince William Sound: U.S. Geological Survey data release, https://doi.org/10.5066/P9EDM6NL.

U.S. Geological Survey - Alaska Science Center, National Park Service - Southwest Alaska Inventory and Monitoring Network, and University of Alaska Fairbanks - College of Fisheries and Ocean Sciences, 2016, Intertidal temperature data from Kachemak Bay, Prince William Sound, Katmai National Park and Preserve, and Kenai Fjords National Park (ver 3.0, August 2022): U.S. Geological Survey data release, https://doi.org/10.5066/F7WH2N3T.

U.S. Geological Survey - Alaska Science Center, National Park Service - Southwest Alaska Inventory and Monitoring Network, and University of Alaska Fairbanks, 2018, Intertidal soft-sediment bivalves from Prince William Sound, Kachemak Bay, Katmai National Park and Preserve, and Kenai Fjords National Park (ver 2.0, September 2022): U.S. Geological Survey data release, https://doi.org/10.5066/F71834N0.

U.S. Geological Survey - Alaska Science Center, National Park Service - Southwest Alaska Inventory and Monitoring Network, and University of Alaska Fairbanks - College of Fisheries and Ocean Sciences, 2017, Black Oystercatcher Nest and Diet Data from Kachemak Bay, Katmai National Park and Preserve, Kenai Fjords National Park, and Prince William Sound, 2006-2022 (ver 2.0, September 2022): U.S. Geological Survey data release, https://doi.org/10.5066/F7WH2N5Q.

Van Hemert, C. R., S. K. Schoen, R. W. Litaker, M. M. Smith, M. L. Arimitsu, J. F. Piatt, W. C. Holland, D. R. Hardison, and J. M. Pearce. 2019. Algal toxins in seabirds, forage fish, and marine invertebrates, Gulf of Alaska, 2015-2017: U.S. Geological Survey data release. https://doi.org/10.5066/P9UNY0FR.

von Biela, V. R., M. L Arimitsu, J. F. Piatt, B. Heflin, S. K. Schoen, J. L. Trowbridge, and C. M. Clawson. 2019, Pacific Sand Lance Energy Density, Length, and Age, Prince William

Sound, Alaska, 2012-2016: U.S. Geological Survey data release. https://doi.org/10.5066/P96N5PVE.

Scientific Presentations

Aderhold, D. 2018. An overview of Gulf Watch Alaska. Presentation. Oral presentation, Cook Inlet Regional Citizens' Advisory Council Board of Directors meeting, Homer, Alaska, September.

Aguilar-Islas, A. M. 2020. The Northern Gulf of Alaska Long Term Ecological Research Site: Nutrient dynamics across the shelf from Kayak to Kodiak islands. Invited presentation at the University of South Florida, Tampa, Florida.

Aguilar-Islas, A., M. R. Kaufman, and S. Strom. 2020. Nutrient dynamics and their influence in the Northern Gulf of Alaska (ME34E-0212). Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Arimitsu, M. L. 2017. Biophysical linkages between glacier runoff and coastal marine ecosystems: Perspectives from Alaska. International Arctic Research Policy Committee Glaciers and Sea Level and Marine Ecosystems collaboration. May.

Arimitsu, M. L. 2018. Monitoring forage fish in Alaska: Detecting change in non-commercial prey populations. Department of Fisheries and Oceans Canada forage fish workshop. Pacific Biological Station, Nanaimo, British Columbia.

Arimitsu, M. 2019. Northern Gulf of Alaska forage fish sampling in 2018, connectivity between LTER and GWA Ecosystem Monitoring Programs. Oral presentation, NGOA LTER PI meeting. Fairbanks, Alaska, January.

Arimitsu, M. L. 2020. Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Synthesis Workshop, Anchorage, Alaska, February.

Arimitsu, M. 2022. VAST Joint Dynamic Species Distribution Models of at-sea seabird survey data. USGS-ASC Ecosystems Seminar, January.

Arimitsu, M. 2022. Sentinels of change. Keynote address, American Fisheries Society Alaska Chapter, March.

Arimitsu, M. 2022. Changes in marine predator and prey populations in the Northern Gulf of Alaska: Gulf Watch Alaska Pelagic Update 2021. Virtual poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M., M. A. Bishop, D. Cushing, S. Hatch, R. Kaler, K. Kuletz, L. Labunski, C. Matkin, J. Moran, D. Olsen, J. Piatt, A. Schaeffer, and J. Straley. 2022. Changes in marine predator and prey populations in the Northern Gulf of Alaska: Gulf Watch Alaska Pelagic

update 2022. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M., M. A. Bishop, D. Cushing, S. Hatch, B. Helfin, R. Kaler, K. Kuletz, et al. 2018. Changes in marine predator and prey populations in the aftermath of the North Pacific Heat Wave: Gulf Watch Alaska Pelagic update 2017. Poster presentation, Annual meeting of the Pacific Seabird Group, La Paz, Mexico, February.

Arimitsu, M., M. Bishop, D. Cushing, S. Hatch R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, J. Piatt, A. Schaeffer, and J. Straley. 2019. Changes in marine predator and prey populations in the Northern Gulf of Alaska: Gulf Watch Alaska pelagic update 2019. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M., M. A. Bishop, D. Cushing, S. Hatch, R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, J. Piatt, A. Schaefer, and J. Straley. 2020. Changes in marine predator and prey populations in the Northern Gulf of Alaska: Gulf Watch Alaska Pelagic update 2019. Poster presentation, Alaska Marine Science Symposium. Anchorage, Alaska, January.

Arimitsu, M. L., M. A. Bishop, S. Hatch, R. Kaler, K. Kuletz, C. Matkin, J. Moran, D. Olsen, J. F. Piatt, A. Schaeffer, and J. Straley. 2018. Changes in marine predator and prey populations in the aftermath of the North Pacific heat wave: Gulf Watch Alaska Pelagic update 2017. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M. L., S. Pegau, J. Piatt, B. Heflin, and S. Schoen. 2017. Spatial and temporal variability of forage fish in coastal waters of Prince William Sound, Alaska, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M., and J. Piatt. 2022. Shifting baselines as forage fish respond rapidly to climate change stressors in Alaska. USGS Pacific Coast Diadromous and Marine Fish Symposium, September.

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M. Bishop, R. Cambell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2021. Heatwave-induced synchrony within forage fish portfolio disrupts energy flow to top pelagic predators. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M., J. Piatt, S. Hatch, R. Suryan, S. Batten, M.A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2021. Forage collapse underpinned a large-scale seabird die-off during the prolonged marine heatwave in the Gulf of Alaska. World Seabird Conference, October.

Arimitsu, M. L., J. Piatt, B. Heflin, and S. Schoen. 2017. Jellyfish blooms in warm water may signal trouble for forage fish in a warming climate. ICES/PICES Symposium on Drivers of Dynamics of Small Pelagic Fish Resources, March.

Arimitsu, M. L., J. F. Piatt, B. Heflin, S. K. Schoen, and V. R. von Biela. 2018. Ripples of the North Pacific heatwave: signals from seabirds and their forage base in the Gulf of Alaska. Ocean Sciences, Portland, Oregon, February.

Arimitsu, M. L., J. F. Piatt, S. K. Schoen, B. H. Heflin, V. R. von Biela, and S. Hatch. 2018. Changes in forage fish during the winter 2015-16 seabird die-off and the North Pacific marine heat wave. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Arimitsu, M., J. Piatt, R. M. Suryan, S. Batten, M. Bishop, R. W. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Hatch, S. Haught, R. Hopcroft, K. J. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, S. Pegau, A. Schaefer, S. Schoen, J. Straley, and V. R. von Biela. 2020. Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop, Anchorage, Alaska, February.

Arimitsu, M., J. Piatt, R. Suryan, S. Batten, M. A. Bishop, R. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Hatch, S. Haught, R. Hopcroft, K. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, W. S. Pegau, A. Schaeffer, S. Schoen, J. Straley, and V. von Biela. 2020. Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. Oral presentation, Pacific Seabird Group Annual Meeting, Portland, Oregon, February.

Arimitsu, M., J. Piatt, R. Suryan, D. Cushing, S. Hatch, K. Kuletz, C. Marsteller, J. Moran, S. Pegau, M. Rogers, S. Schoen, J. Straley, and V. von Biela. 2019. Reduced energy transfer through forage fish disrupted marine food webs during the North Pacific marine heatwave. Oral presentation, North Pacific Marine Science Organization (PICES) annual meeting, Victoria, British Columbia, Canada, October.

Arimitsu, M., J. Thorson, J. Piatt, G. Drew, K. Kuletz, W. Sydeman, et al. 2021. Spatio-temporal modeling provides VAST possibilities for analysis of at-sea survey data. Virtual oral presentation, Annual meeting of the Pacific Seabird Group, February.

Batten, S. D. 2018. Lower Trophic Level Variability Across the Subarctic North Pacific, From Continuous Plankton Recorder Sampling. Oral presentation, Ocean Sciences, Portland, Oregon, February.

Batten, S. D., S. Chiba, D. Mackas, D. Moore, and C. Ostle. 2019. Two decades of the North Pacific CPR Survey. Poster presentation, OceanObs19, Honolulu, Hawaii, September.

Batten, S. D., S. Chiba, D. Mackas, D. Moore, C. Ostle. 2019. Two decades of the North Pacific CPR Survey. Poster presentation, PICES Annual meeting, Victoria, British Columbia, October.

Batten, S. D., S. Chiba, D. Mackas, D. Moore, and C. Ostle. 2020. Two decades of the North Pacific CPR Survey. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Batten, S. D, A. Walne, and P. Helaouet. 2019. Impact of the marine heat wave on Gulf of Alaska plankton communities. Has normal service now been resumed? Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Batten, S. D., A. W. Walne, and P. Hélaouët. 2019. Impact of the marine heat wave on Gulf of Alaska plankton communities. Invited speaker, PICES Annual meeting, Victoria, British Columbia, October.

Block, L. 2022. Exploring zooplankton community shifts in the Northern Gulf of Alaska using a new analysis approach to maintain taxonomic and spatiotemporal complexity. Virtual poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Block, L. 2022. A new approach for exploring spatiotemporal patterns and community shifts in zooplankton data. Virtual poster presentation, Ocean Sciences Meeting, March.

Bodkin, J., H. Coletti, B. Ballachey, D. Monson, T. Dean, D. Esler, G. Esslinger, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, and B. Weitzman. 2018. Detecting and inferring cause of change in Alaska nearshore marine ecosystem: An approach using sea otters as a component of the nearshore benthic food web. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Bodkin, J., H. Coletti, D. Esler, B. Konar, K. Iken, B. Ballachey, J. Bodkin, A. Doroff, G. Esslinger, K. Kloecker, M. Lindeberg, D. Monson, B. Robinson, S. Traiger, and B. Weitzman. 2021. Flexing their mussels: Sea otter diet shifts in response to mussel abundance. Oral presentation, Sea Otter Conservation Workshop, Seattle, Washington, March.

Bodkin, J. L., B. E. Ballachey, G. E. Esslinger, B. P. Weitzman, A. M. Burdin, L. Nichol and H. A. Coletti. 2017. A century of sea otter science and conservation in National Parks. Oral presentation, Sea Otter Conservation Workshop, Seattle, Washington, March.

Boswell, K., R. Heintz, J. Vollenweider, J. Moran, and S. LaBua. 2020. The decline of acoustic backscatter associated with overwintering Pacific herring (*Clupea pallasii*) in Lynn Canal, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Bowen, L., H. A. Coletti, B. Ballachey, T. Hollmen, S. Waters, and K. Counihan. 2018. Transcription as a Tool for Assessing Bivalve Responses to Changing Ocean Conditions. Oral presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Brydie, A., and S. Danielson. 2019. Copper River Plume. LTER REU Mini-Symposium, August.

Brydie, A., and S. L. Danielson. 2020. Copper River discharges in the Northern Gulf of Alaska: freshwater distribution and evolution during the July 2019 freshet, Poster presentation, AGO-ASLO Ocean Sciences Meeting, San Diego, California, February.

Burt, W., R. Hopcroft, S. Danielson, and S. Strom. 2020. Quantifying phytoplankton biomass and productivity at unprecedented spatial scales in the Northern Gulf of Alaska LTER Program using ship-board optical measurements. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Burt, W., R. R. Hopcroft, S. Strom, and S. L. Danielson. 2020. Use of ship-board optical measurements to quantify plankton biomass and productivity across multiple trophic levels in the Northern Gulf of Alaska LTER program (OB24C-0479). Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Busse, H., J. Fiechter, and S. Strom. 2020. Grazing rates of mixotrophic nano- and dinoflagellates in the Northern Gulf of Alaska in response to gradients in light, inorganic nutrients, and prey availabilities. Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Campbell, R. W. 2022. The Prince William Sound plankton camera: A profiling *in situ* observatory of plankton and particulates. Oral presentation, PICES Annual Meeting, Busan, South Korea, October.

Campbell, R. W. 2018. A Profiling Observatory for High Resolution Oceanographic, Biogeochemical, and Plankton Observations in Prince William Sound. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Campbell, R. W. 2018. A Profiling Observatory for High Resolution Oceanographic, Biogeochemical, and Plankton Observations in Prince William Sound. Oral presentation, ASLO Ocean Sciences Meeting, Portland, Oregon, February.

Campbell, R. W. 2021. Impacts of the recent marine heat waves on the oceanography and plankton ecosystem of Prince William Sound. Virtual poster presentation, Alaska Marine Science Symposium, Alaska, January.

Campbell, R. W. 2022. A long term comparison of net-caught versus image-based estimates of zooplankton concentrations in Prince William Sound, Alaska. Virtual presentation, ASLO/TOS/AGU Ocean Sciences Meeting, February.

Campbell, R. W. 2022. Monitoring plankton with cameras? Intercalibration of *in-situ* imagery and net based estimates of plankton concentrations and observations from a multiyear time series of high frequency observations in Prince William Sound. Virtual poster presentation, Alaska Marine Science Symposium, January.

Campbell, R. W., J. Jaffe, and P. Roberts. 2019. The PWS plankton cam: An *in-situ* look into the zooplankton ecosystem of Prince William Sound. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Campbell, R. W., P. L. Roberts, and J. Jaffe. 2020. The annual secondary productivity cycle in Prince William Sound measured with the Prince William Sound plankton camera. Oral presentation, ASLO Ocean Sciences Meeting, San Diego, California, February.

Campbell, R. W., P. L. Roberts, and J. Jaffe. 2020. The annual secondary productivity cycle in Prince William Sound measured with the Prince William Sound plankton camera. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Cohen, J. 2022. Investigating the impact of marine heatwaves on phytoplankton community composition in the Gulf of Alaska. Virtual oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Coleman, D. 2022. Lipid accumulation in Neocalanus copepods in the Northern Gulf of Alaska (NGA). Virtual oral presentation at the Alaska Marine Science Symposium, Anchorage, Alaska, January.

Coleman, D. 2022. Lipid accumulation in Neocalanus copepods in the Northern Gulf of Alaska (NGA). Virtual oral presentation, Ocean Sciences Meeting, March.

Coleman, D., and R. Hopcroft. 2021. Habitat utilization by diapausing copepods in the Northern Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Coletti, H. A. 2019. Gulf Watch Alaska overview and updates. Oral presentation, MARINe and BOEM joint meeting. September.

Coletti, H., L. Bowen, B. Ballachey, T. L. Wilson, M. Booz, K. Counihan, T. Hollmen, S. Waters, and B. Pister. 2021. Gene transcription profiles in two razor clam populations. Oral presentation, Kachemak Bay Science Symposium, Homer, Alaska, March.

Coletti, H., D. Esler, B. Ballachey, J. Bodkin, T. Dean, G. Esslinger, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, D. Monson, B. Robinson, and B. Weitzman. 2018. A decade's worth of data: Key metrics from a large-scale, trophic web based long term monitoring program in the northern Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Coletti, H. A., G. Hilderbrand, D. Monson, J. Erlenbach, B. Ballachey, B. Pister and B. Mangipane. 2019. Where carnivores clash: Evidence of competition - Prey-shifting by brown bears during a period of sea otter recovery. Oral presentation, Sea Otter Conservation Workshop, Seattle, Washington, March.

Coletti, H. A., P. Martyn, D. H. Monson, D. Esler and A. E. Miller. 2018. Using small unmanned aircraft systems (sUAS) to map intertidal topography in Katmai National Park and Preserve, Alaska. Poster presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Coletti, H.A., R. Suryan, D. Esler, R. Kaler, T. Hollmen, M. Arimitsu, J. Bodkin, T. Dean, K. Kloecker, K. Kuletz, J. Piatt, B. Robinson, and B. Weitzman. 2019. Birds of a feather flock together… or do they? Regional and temporal patterns of community composition and abundance in nearshore marine birds across the Gulf of Alaska. Oral presentation, Alaska Bird Conference, Fairbanks, Alaska, March.

Collins, E. 2018. Microbial community structure in Prince William Sound. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Counihan, K., L. Bowen, B. Ballachey, H. Coletti, T. Hollmen, and B. Pister. 2019. Physiological and gene transcription assays in combinations: a new paradigm for marine intertidal assessment. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Coyle, K. O., A. J. Hermann, and R. R. Hopcroft. 2018. Modeled spatial-temporal distribution of production and biomass relative to field observations in the northern Gulf of Alaska. Oral presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Cushing, D. 2022. Two decades of spring seabird observations along the Seward Line, Gulf of Alaska. Virtual oral presentation, Alaska Marine Science Symposium, January.

Cushing, D., K. Kuletz, R. R. Hopcroft, S. L. Danielson, and E. Labunski. 2017. Shifts in cross-shelf distribution of seabirds in the northern Gulf of Alaska under different temperature regimes, 2007-2015. Poster presentation, Pacific Seabird Group Meeting, Tacoma, Washington, February.

Cushing, D., K. Kuletz, E. Labunski, and R. Hopcroft. 2019. Seabird studies during the Northern Gulf of Alaska Long Term Ecological Research Program. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Cushing, D., E. Labunski, and K. Kuletz. 2021. Summer tourists: The rare, amazing, and out-of-their-range visitors observed during seabird surveys in the Northern Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Cushing, D. A., K. J. Kuletz, L. Sousa, R. H. Day, S. L. Danielson, E. A. Labunski, and R. R. Hopcroft. 2022. Two decades of spring seabird observations along the Seward Line, Gulf of Alaska. Oral presentation. Alaska Marine Science Symposium, Virtual, January.

Danielson, S. L. 2018. It is a finescale line: Acrobat observations from along the Gulf of Alaska hydrographic tightrope. Poster presentation, LTER All Scientists' Meeting, Pacific Grove, California, September.

Danielson, S. L. 2018 The short and the long of it: the importance of high-resolution Alaskan marine process studies and monitoring. Oral presentation, UAF-CFOS FOS Seminar, Fairbanks, Alaska, September.

Danielson, S. L. 2017. UAF-IMS seminar: Marine heatwaves in the North Pacific and Arctic, 2013-2017, Fairbanks Alaska, November.

Danielson, S. L. 2017. UAF Site Review: Northern Gulf of Alaska Marine Ecosystem Monitoring, M. J. Murdock Charitable Trust, August.

Danielson, S. L. 2018. The short and the long of it: the importance of high-resolution Alaskan marine process studies and monitoring. Oral presentation, UAF-CFOS FOS Seminar, Fairbanks, Alaska, September.

Danielson, S. 2019. Presentation to the Alaska Ocean Observing System Board, Anchorage, Alaska, December.

Danielson, S. 2019. 21st century oceanography in the last frontier. Invited keynote presentation, University National Oceanographic Laboratory System (UNOLS) Research Vessel Technical Enhancement Committee (RVTEC) meeting, Fairbanks, Alaska, November.

Danielson, S. 2019. Changing stratification over Alaska region continental shelves suggests altered diapycnal mixing and nutrient fluxes, Invited talk, 3rd International Ocean Mixing Processes: Impact on Biogeochemistry, Climate and Ecosystem Symposium, Tokyo, Japan, May.

Danielson, S. L. 2020. Freshwater in the Gulf of Alaska: New observations and model results. Distance video presentation, NOAA Coastal and Marine Modeling Branch (CMMB) seminar series, December.

Danielson, S. L. 2020. Presentation to the Northern Gulf of Alaska Long Term Ecological Research Program: 2020 Field Updates, November.

Danielson, S. 2020. Presentation to the Northern Gulf of Alaska Long Term Ecological Research Program PI meeting, January.

Danielson, S. L. 2021. Presentation to the Northern Gulf of Alaska Long Term Ecological Research Program PI meeting, January.

Danielson, S., T. D. Hennon, D. H. Monson, R. M. Suryan, R. W. Campbell, S. J. Baird, K. Holderied, and T. J. Weingartner. 2020. A study of marine temperature variations in the northern Gulf of Alaska across years of marine heatwaves and cold spells. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Review Panel Science Synthesis Workshop, Anchorage, Alaska, February.

DeCino, K., K. Holderied, B. Weitzman, and M. Renner. 2021. State of Kachemak Bay: A tool for understanding and reporting change. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Dias, B. S. 2022. Impact of marine heatwaves on Pacific herring and Prince William Sound marine ecosystem. Virtual oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Dias, B. 2022. Effects of marine heatwaves persistence in Prince William Sound herring. Virtual oral presentation, Ocean Sciences Meeting 2022, February.

Dias, B. 2022. Prince William Sound marine ecosystem under different heatwave scenarios. Oral presentation, Ecosystem Studies of Subarctic and Arctic Seas (ESSAS) Annual Science Meeting, Seattle, Washington, June.

Dias, B. S., D. W. McGowan, R. W. Campbell, and T. A. Branch. 2021. What affects spawning phenology of herring (*Clupea pallasii*) in Prince William Sound? Virtual oral presentation, Alaska Marine Science Symposium, January.

Donnelly, D., M. Arimitsu, S. Pegau, and J. Piatt. 2022. Spatial and temporal variation in forage fish using broad-scale and cost-effective aerial surveys in Prince William Sound 2010-2021. Oral presentation, American Fisheries Society Alaska Chapter, March.

Dorsaz, T., and B. Konar. 2019. Clam predation patterns as a way of understanding sea star wasting disease's impacts in Kachemak Bay. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Douglas, D., J. Piatt, M. Arimitsu, E. Madison, M. Kissling, and S. Schoen. 2019. Post-breeding migration of Kittlitz's murrelet *Brachyramphus brevirostris* from the Gulf of Alaska to the Bering Sea and beyond. American Ornithologist Union, Anchorage, Alaska, June.

Dowling, A., B. Konar B, and K. Iken K. 2020. Size distribution variability in Pacific blue mussels (*Mytilus trossulus*) in glacially influenced estuaries. Poster presentation, World Conference on Marine Biodiversity, Auckland, Australia, December.

Dowling, A., B. Konar, and K. Iken. 2020. Variability in Pacific Blue Mussel (*Mytilus trossulus*) demographics in a glacially influenced estuary. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Dowling, A., B. Konar, and K. Iken. 2021. Size distribution variability in Pacific blue mussels (*Mytilus trossulus*) in glacially influenced estuaries. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Du, X., R. Campbell, S. Kibler, K. Holderied, D. Hondolero, K. Schuster, R. Robinson, M. Arimitsu, and J. Piatt. 2019. Prevalence of paralytic shellfish toxins in the marine food webs of Prince William Sound and Kachemak Bay, Alaska. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Du., X., R. W. Campbell, S. Kibler, and B. Wright. 2021. Seasonal dynamics of the harmful dinoflagellate *Alexandrium* and associated paralytic shellfish toxin contamination in shellfish: NPRB 1801 project updates for Prince William Sound. Virtual poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Esler, D. 2017. Sea ducks as indicators of nearshore marine conditions. Oral presentation, 6th International Sea Duck Conference, San Francisco, California, February.

Esler, D. 2017. Sea duck traits: Their influence on oil spill vulnerability and restoration potential. Oral presentation, 6th International Sea Duck Conference, San Francisco, California, February.

Esslinger, G. G., H. A. Coletti, J. L. Bodkin, D. H. Monson, B. E. Ballachey, T. A. Dean, and D. Esler. 2017. Contrasting demography and behavior among sea otter populations in the northern Gulf of Alaska. Oral presentation, Alaska Chapter of The Wildlife Society Annual Meeting, Fairbanks, Alaska, April.

Esslinger, G. G., H. A. Coletti, J. L. Bodkin, D. H. Monson, B. E. Ballachey, T. A. Dean, and D. Esler. 2017. Trends and equilibrium density vary among sea otter populations in the northern Gulf of Alaska. Oral presentation, Sea Otter Conservation Workshop, Seattle, Washington, March.

Esslinger, G., K. Kloecker, D. Monson, J. Bodkin, B. Weitzman, B. Ballachey, H. Coletti, D. Esler, T. Tinker, J. Tomoleoni, N. LaRoche, and J. Womble. 2021. Dietary patterns and energy intake rates of sea otters recolonizing Glacier Bay. Oral presentation. Sea Otter Conservation Workshop, March.

Fredrickson, K., H. Busse, D. Walker-Phelan, C. Mazur, and S. Strom, S. 2020. Unexpected Importance of the Smallest Phytoplankton in the Northern Gulf of Alaska Ecosystem. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Gavenus, K. A. 2022. NGA LTER near & far: Spatial & temporal scales of our education efforts. Poster presentation, LTER All Scientists Meeting 2022, Asilomar, California, September.

Griffin, K., and H. Coletti. 2020. Seabird colonies on the Katmai coast. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hasan, L., B. Konar, T. Jones, and H. Coletti. 2021. Subtidal habitat mapping in Cook Inlet for current and predictive sea otter habitat associations. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hauri, C. 2022. January. Modulation of ocean acidification by decadal climate variability in the Gulf of Alaska. Virtual oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hauri, C., and S. C. Doney. 2021. Freshwater inputs change ocean acidification impacts on nearshore biogeochemistry in the Gulf of Alaska. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hauri, C., K. Hedstrom, C. Schultz, S. Danielson, J. Beamer, S. C. Doney, et al. 2019. Influence of ocean acidification and climate change on the biogeochemistry in the Gulf of Alaska: A regional modeling study. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hauri, C., C. Schultz, K. Hedstrom, J. Beamer, S. L. Danielson, S. C. Doney, et al. 2018. Influence of ocean acidification and climate change on the biogeochemistry of the Gulf of Alaska. Oral presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Hennon, G., and J. Fiechter. 2022. Variability and trends in the Northern Gulf of Alaska ecosystem. Poster presentation, LTER All Scientists Meeting 2022, Asilomar, California, September.

Hernandez, A., and R. R. Hopcroft. 2020. The effects of environmental changes in the Northern Gulf of Alaska on the synthesis of lipid in *N. flemingeri* and *N. plumchrus* from 2018 to 2019. Poster presentation, Ocean Sciences Meeting, San Diego, California.

Hill, D. 2022. Improved freshwater runoff estimates for Alaska – a project update. Virtual poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Holderied, K. 2019. Gulf Watch Alaska: Ecosystem Monitoring (and data for you?) in the northern Gulf of Alaska. Public seminar for NOAA National Marine Fisheries Service/Alaska Fisheries Science Center Groundfish Seminar series, Seattle, Washington, October.

Holderied, K., S. Baird, J. Schloemer and D. Hondolero. 2020. Impact of the warm, dry 2019 summer on nearshore waters in Kachemak Bay, Alaska – rain versus glacial melt? Oral presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Holderied, K., M. Renner, A. Jyzk, D. Hondolero, and B. Weitzman. 2021. Speed dating through meroplankton? Linking ocean and nearshore ecosystems in Kachemak Bay, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Holderied, K., J. Schloemer, K. Powell Schuster, S. Baird, and D. Hondolero. 2019. Seasonal and spatial variability in ocean acidification conditions in Kachemak Bay and Cook Inlet Alaska. Poster presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hondolero, D., T. Bell, B. Weitzman, and K. Holderied. 2020. Kelp forest mapping in Kachemak Bay, Alaska using a drone. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hondolero, D., M. Renner, and K. Holderied. 2023. Phytoplankton monitoring in Kachemak Bay, Alaska. Poster presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hopcroft, R. R. 2017. Oceanography in the northern Gulf of Alaska: the Seward Line. Public lecture, Osher Lifelong Learning Institute, Fairbanks, Alaska, December.

Hopcroft, R. R. 2018. The Seward Line – 2017. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hopcroft, R. R., A. Aguilar-Islas, S. L. Danielson, J. Feichter, and S. Strom. 2018. NGA-LTER Overview. LTER PI Meeting, Asilomar, California, September.

Hopcroft, R., A. Aguilar-Islas, S. Danielson, J. Fiechter, A. McDonnell, and S. Strom. 2019. The Northern Gulf of Alaska LTER: Results from the first year. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hopcroft, R. R., K. O. Coyle, S. L. Danielson, and S. L. Strom. 2017. Three in a row: Continued warm conditions along the Gulf of Alaska's Seward Line. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hopcroft, R. R., K. O. Coyle, S. L. Danielson, and S. L. Strom. 2017. Twenty years of observations along the Gulf of Alaska's Seward Line: Impact of continued warm conditions. Invited presentation, Kodiak Area Marine Science Symposium, Kodiak, Alaska, April.

Hopcroft, R. R., and D. J. Lindsay. 2018. Gelatinous zooplankton in Alaskan waters: From nets to ROVs. Invited presentation, PICES Annual Meeting, Yokohama, Japan, October.

Hopcroft, R. R., S. L. Strom, A. M. Aguilar-Islas, S. L. Danielson, and J. Fiechter, J. 2018. The Northern Gulf of Alaska Long-term Ecological Research Program. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Hopcroft, R. R., S. Strom, A. M. Aguilar-Islas, S. L. Danielson, and J. Fiechter. 2018. A new Long-term Ecological Research (LTER) site in the Northern Gulf of Alaska. Poster presentation, PICES Annual Meeting, Yokohama, Japan, October.

Iken, K., and B. Konar. 2018. Nearshore Gulf Watch Alaska monitoring in Kachemak Bay. Oral presentation, Kachemak Bay Science Conference, Homer, Alaska, March.

Iken, K., and B. Konar. 2018. Freezing in a warming climate? Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Iken, K., and B. Konar. 2018. Nearshore Gulf Watch Alaska monitoring in Kachemak Bay. Poster presentation, Kachemak Bay Science Conference, Homer, Alaska, March.

Iken K., B. Konar, D. Esler, B. Weitzman, H. Coletti, D. Monson, B. Ballachey, T. Dean, and J. Bodkin. 2017. Spatial variability in mussel size frequency distribution in the Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Kaler, R. 2021. Summer marine bird population trends in Prince William Sound, Alaska, 1989-2018. Poster Presentation. Pacific Seabird Group Annual Meeting, Virtual, February.

Kandel, A., and A. Aguilar-Islas. 2020. Temporal variability of dissolved aluminum and manganese in the Northern Gulf of Alaska. Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Kibler, S., X. Du, R. W. Campbell, K. Holderied, D. Hondolero, K. Powell Schuster, R. Robinson, M. Arimitsu, and J. Piatt. 2019. NPRB 1801: Prevalence of paralytic shellfish toxins in the marine food webs of Prince William Sound and Kachemak Bay, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Kibler, S., B. Wright, X. Du, R. W. Campbell, K. Holderied, D. Hondolero, R. Masui, C. Guo, and C. Walker. 2020. NPRB 1801 – Prevalence of paralytic shellfish toxins in the marine food web of southcentral and southwest Alaska: Year 1 update. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Kloecker, K. A., D. H. Monson, B. Robinson, H. A. Coletti, B. E. Ballachey, and D. Esler. 2017. Correlates between sea otter diet and prey energetics in a mussel-specialist population. Oral presentation, Sea Otter Conservation Workshop, Seattle, Washington, March.

Konar, B., K. Iken, H. Coletti, T. Dean, D. Esler, B. Weitzman, K. Kloecker, and M. Lindeberg. 2017. Trends in intertidal sea star abundance and diversity across the Gulf of Alaska:

looking for effects of sea star wasting. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Konar, B., K. Iken, H. Coletti, T. Dean, D. Esler, K. Kloecker, M. Lindeberg, B. Pister, and B. Weitzman. 2018. Trends in intertidal sea star abundance and diversity across the Gulf of Alaska: Effects of sea star wasting. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Konar, B., K. Iken, H. Coletti, T. Dean, D. Esler, K. Kloecker, M. Lindeberg, B. Pister, and B. Weitzman. 2018. Trends in intertidal sea star abundance and diversity across the Gulf of Alaska: Effects of sea star wasting. Oral presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Konar, B., K. Iken, H. Coletti, T. Dean, D. Esler, K. Kloecker, M. Lindeberg, B. Pister, and B. Weitzman. 2018. Trends in intertidal sea star abundance and diversity across the Gulf of Alaska: Effects of sea star wasting. Oral presentation. Kachemak Bay Science Conference, Homer, Alaska, March.

Kuletz, K., D. Cushing, R. R. Hopcroft, S. L. Danielson, and E. Labunski. 2017. Running hot and cold: Shifts in seabird distribution in the Northern Gulf of Alaska under different temperature regimes, based on Seward Line surveys, 2007-2015. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Kuletz, K., D. Cushing, and E. Labunski. 2021. Short-tailed shearwater timing and movement through Alaska's seas, based on at-sea surveys, 2007-2019. Virtual oral presentation, Annual meeting of the Pacific Seabird Group, February.

Kuletz, K., B. Hoover, D. Cushing, J. Santora, W. Sydeman, R. R. Hopcroft, S. Danielson, and E. Labunski. 2019. Seabird distribution relative to biophysical oceanographic properties in North Pacific ecosystems. Oral presentation, Annual meeting of the Pacific Seabird Group, Lihue, Kuai, Hawaii, March.

Kuletz, K., R. R. Hopcroft, S. L. Danielson, J. Santora, W. Sydeman, B. Hoover, and D. Cushing. 2018. Seabird distribution relative to biophysical oceanographic properties in North Pacific ecosystems. Poster presentation, 2018 LTER All Scientists' Meeting, Pacific Grove, California, October.

Kurtz, D., D. Esler, T. Jones, B. Weitzman, and B. Robinson. 2019. Spatial and temporal patterns in nearshore physical oceanography in tidewater glacial fjords. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Heflin, B., G. Drew, J. Piatt, and M. Arimitsu. 2019. North Pacific pelagic seabird database v3 – Data compilation effort to facilitate spatial and temporal analyses of at-sea marine bird surveys in the North Pacific. Pacific Seabird Group meeting, Kauai, Hawaii, February.

LaBua, S., K. Boswell, J. Vollenweider, and J. Moran. 2021. The decline of acoustic backscatter associated with overwintering herring (*Clupea pallasii*) in Lynn Canal, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Lenz, P. H. 2017. Ecophysiology of marine copepods in a cyclical and changing environment. Invited presentation, Institute of Marine Science, University Alaska Fairbanks, Fairbanks, Alaska, September.

Lenz, P., M. Cieslak, A. M. Castelfranco, D. K. Hartline, and V. Roncalli. 2021. Environmental transcriptomics of seasonal dormancy in a sub-arctic copepod, a key crustacean zooplankter at the base of the metazoan food web. Virtual invited presentation, National Center for Genome Analysis Support Genomics Research webinar series, March.

Lenz, P. H., V. Roncalli, M. C. Cieslak, S. A. Matthews, C. Clarke-Hopcroft, and R. R. Hopcroft. 2017. Emergence from diapause in *Neocalanus flemingeri* females: Physiological and morphological progression. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Lenz, P. H., V. Roncalli, M. C. Cieslak, S. A. Matthews, D. K. Hartline, and A. E. Christie. 2017. Adventures in transcriptomics. Oral presentation, Aquatic Sciences Meeting (ASLO), Honolulu, Hawaii, March.

Lenz, P. H., V. Roncalli, D. K. Hartline, M. Germano, M. C. Cieslak, S. L. Strom, and R. R. Hopcroft. 2018. The physiological ecology of the calanid copepod, *Neocalanus flemingeri* in the northern Gulf of Alaska. Oral and poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Lindeberg, M. 2017. The long-term monitoring program of the *Exxon Valdez* Trustee Council. Oral presentation, Briefing to the *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska, November.

Lindeberg, M. 2017. We are watching – the long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council. Oral presentation, Prince William Sound Regional Citizens' Advisory Council Science Night, Anchorage, Alaska, December.

Lindeberg, M. 2018. Gulf Watch Alaska program overview. Speed talk, Recruitment Process Alliance Annual Meeting. Juneau, Alaska, March.

Lindeberg, M. 2018. Gulf Watch Alaska program overview. Speed talk, Ocean Sciences Conference, Portland, Oregon, February.

Lindeberg, M. 2018. Gulf Watch Alaska program overview. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska, November.

Lindeberg, M. 2018. Science without borders – is it possible? Plenary presentation, Kachemak Bay Science Conference. Homer, Alaska, March.

Lindeberg, M. R. 2019. Long-term programs of the *Exxon Valdez* Oil Spill Trustee Council. Oral presentation, Alaska Forum on the Environment, Anchorage, Alaska, February.

Lindeberg, M. 2020. Gulf Watch Alaska program: Website overview. Oral presentation. EVOSTC Public Advisory Committee. *Exxon Valdez* Oil Spill Trustee Council Science Synthesis Workshop, Anchorage, Alaska, February.

Lindeberg, M., and J. Bodkin. 2020. Gulf Watch Alaska: Program overview and highlights and monitoring upper trophic consumers in the nearshore. Virtual oral presentation, Multi-Agency Rocky Intertidal Network (MARINe) Annual Workshop, March.

Lindeberg, M., R. A. Heintz, and J. Maselko. 2018. Decadal persistence of *Exxon Valdez* Oil in Prince William Sound – that was not anticipated. Poster presentation, Ocean Sciences Conference, Portland, Oregon, February.

Lindeberg, M., K. Holderied, D. Aderhold, K. Hoffman, M. Arimitsu, H. Coletti, and R. Hopcroft. 2017. Gulf Watch Alaska: Results from five years of ecosystem monitoring in the northern GOA. Oral presentation, 2017 National Marine Fisheries Service Alaska Fisheries Science Center mini symposium.

Lindeberg, M., M. McCammon, K. Holderied, K. Hoffman, D. Aderhold, R. Hopcroft, M. Arimitsu, and H. Coletti. 2017. Five years of ecosystem monitoring in the Northern Gulf of Alaska. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Lindeberg, M., R. Suryan, D. Aderhold, and K. Hoffman. 2020. Gulf Watch Alaska: Program overview and highlights (FY2012-2019). Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Public Advisory Committee. *Exxon Valdez* Oil Spill Trustee Council Science Synthesis Workshop, Anchorage, Alaska, February.

Lindeberg, M., R. Suryan, D. Aderhold, and K. Hoffman. 2020. Gulf Watch Alaska program overview and highlights (FY2012-2019). Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop, Anchorage, Alaska, February.

Lindeberg, M., R. Suryan, D. Aderhold, and K. Hoffman. 2020. Gulf Watch Alaska program recommendations. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Review Panel. Science Synthesis Workshop, Anchorage, Alaska, February.

Lindeberg, M., R. Suryan, D. Aderhold, K. Hoffman, R. Hopcroft, H. Coletti, and M. Arimitsu. 2018. Gulf Watch Alaska Report: Residual effects of the marine heatwave persist in the

Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Lindeberg, M., R. Suryan, D. Aderhold, K. Hoffman, R. Hopcroft, H. Coletti, M. Arimitsu. 2021. Gulf Watch Alaska: Building partnerships to understand ecosystem change. Virtual poster presentation, Alaska Marine Science Symposium, January.

Lindeberg, M., and S. Traiger. 2021. Changes in nearshore ecosystems and relevance to coastal communities – Gulf of Alaska. Virtual panelists, Alaska Marine Science Symposium, January.

Lowin, B., S. Strom, and W. Burt. 2021. Phytoplankton dynamics across hydrographic fronts and mesoscale features: Preliminary results from the new NGA-LTER Ocean Optics Program. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Lyman, E., R. Finn, J. Moran, K. Savage, C. Gabriele, J. Straley, N. Davis, F. Sharpe, J. Neilson, A. Jensen, D. Schofield, S. Wright, P. Cottrell, T. Rowles, S. Wilkin, M. Lammers, and E. Zang. 2019. Are recent population level changes in the central North Pacific humpback whales, *Megaptera novaeangliae*, affecting entanglement threat and reporting rate? Poster presentation, World Marine Mammal Conference, Barcelona, Spain, December.

Marsteller, C., M. Arimitsu, J. Piatt, K. Kuletz, S. Schoen, B. Heflin, and E. Labunski. 2019. Recent declines in at-sea density of marine birds in Kachemak Bay, Alaska, 1996-2018. Pacific Seabird Group meeting, Kauai, Hawaii, February.

Marsteller, C., M. Arimitsu, J. Piatt, S. Schoen, V. von Biela. 2020. Improved breeding success and foraging conditions in the Gulf of Alaska following the North Pacific marine heatwave. Oral presentation, Pacific Seabird Group Annual Meeting, Portland, Oregon, February.

Martyn, P., D. Monson, H. Coletti, A. Miller, and D. Esler. 2018. Using small unmanned aircraft systems (sUAS) to map intertidal topography in Katmai National Park and Preserve, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Matkin, C. O. 2018. Southern Alaska resident killer whales may be dependent on more than Alaska salmon: some initial stream of origin genetic data from prey samples. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Matthews, S. A., V. Roncalli, M. C. Cieslak, D. K. Hartline, A. E. Christie, and P. H. Lenz. 2017. The transcriptome of *Labidocera madurae*: Evaluation of the quality and depth of a

de novo assembly. Poster presentation, Aquatic Sciences Meeting (ASLO), Honolulu, Hawaii, March.

Mayer, K., C. Clarke-Hopcroft, and R. R. Hopcroft. 2020. Spatial and temporal patterns of zooplankton species in the Gulf of Alaska as revealed by image analysis. Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Mazur, C., S. Strom, and A. Aguilar-Islas. 2020. Comparing the bioavailability of a natural and synthetic iron source: Do past experiments accurately model diatom growth in response to episodic iron addition? Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Mearns, A., D. Janka, S. Pegau, and B. Robinson. 2021. Inter-annual and longterm variability of rocky intertidal biota at selected sites in Prince William Sound, 1989 to 2020. Alaska Marine Science Symposium, Anchorage, Alaska, January.

McGowan, D., M. Arimitsu, K Coyle, A. Dreary, A. De Robertis, E. Goldstein, K. Holderied, J. Horne, O. Ormseth, J. Piatt, L. Rogers, M. Wilson, and S. Zador. 2019. Spatial and temporal dynamics of capelin (*Mallotus villosus*) in the Gulf of Alaska: Implications for fisheries and ecosystem-based management. Alaska Marine Science Symposium, Anchorage, Alaska, January.

McKinstry, C., and R. W. Campbell. 2018. Seasonal variation of zooplankton abundance and community structure in Prince William Sound, Alaska, 2009-2016. Poster presentation, ASLO Ocean Sciences Meeting, Portland, Oregon, February.

McKinstry, C., R. Campbell, and K. Holderied. 2021. Influence of the 2013-2016 marine heatwave on zooplankton community structure in the lower Cook Inlet, Alaska. Poster presentation. Alaska Marine Science Symposium, Virtual, January.

Mendoza Islas, H., and R. Hopcroft. 2020. Abundance and distributions of gelatinous zooplankton in the Northern Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Mendoza Islas, H. M., and R. R. Hopcroft. 2020. First year pollock and their zooplankton predators in the Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Mendoza Islas, H. M., and R. R. Hopcroft. 2020. Abundance and distributions of gelatinous zooplankton in the Northern Gulf of Alaska. Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Monacci, N. M., J. N. Cross, and J. T. Mathis. 2018. Ocean acidification observations along the Seward Line: 2008-2017. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Monell, K., V. Roncalli, P. H. Lenz, and R. R. Hopcroft. 2020. Characterization of cell division during early oogenesis in copepod females emerging from diapause. Poster presentation, Ocean Sciences Meeting, San Diego, California, February.

Monson, D., K. Holderied, R. Campbell, S. Danielson, R. Hopcroft, B. Ballachey, J. Bodkin, H. Coletti, T. Dean, K. Iken, K. Kloecker, B. Konar, M. Lindeberg, B. Robinson, B. Weitzman, and R. Suryan. 2018. Congruence of intertidal and pelagic water and air temperatures during an anomalously warm period in the northern Gulf of Alaska: "The Blob" washes ashore. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Monson, D., R. Taylor, G. Hilderbrand, J. Erlenbach, and H. Coletti. 2019. Top-level carnivores linked across the marine / terrestrial interface: Sea otter haulouts offer a unique foraging opportunity to brown bears. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Monson, D., M. T. Tinker, H. Coletti, G. Esslinger, J. Bodkin, S. Larson, and D. Esler. 2021. Effects of limited dispersal by sea otters on populations dynamics: Relevance to the threatened Southwest Alaska distinct population segment. Sea Otter Conservation Workshop, Seattle, Washington, March.

Monson, D. H., B. P. Weitzman, K. A. Kloecker, D. Esler, L. A. Sztukowsi, S. A. Sethi, H. A. Coletti, and T. Hollmen. 2017. Understanding trophic relationships of sea otters and their effects on demographic attributes. Oral presentation, Sea Otter Conservation Workshop, Seattle, Washington, March.

Moran, J. 2018. A whale of an update. Oral presentation, Auke Bay Laboratory Mini Seminar, Juneau, Alaska, April.

Moran, J. 2018. What do predators tell us about prey? Oral presentation, Juneau Marine Naturalist Symposium, Juneau, Alaska, May.

Moran, J. 2019. Upper trophic conditions: Humpback whales. Oral presentation, Spring PEEC [Preview of Ecosystem and Economic Conditions], an Alaska IEA activity AFSC/PMEL, Seattle, Washington, June.

Moran, J., K. Boswell, and J. Straley. 2017. Humpback whales ruin a perfectly good overwintering strategy for Pacific herring in Alaska. Poster presentation, ICES/PICES, Victoria, British Columbia, February.

Moran, J., C. Gabriele, J. Neilson, K. Savage, and J. Straley. 2018. Recent observations of humpback whales in the Gulf of Alaska: Carrying capacity or a cause for concern? Poster presentation, Ocean Science Meeting, Portland, Oregon, February.

Moran, J., and J. Straley. 2019 Trends in humpback whale (*Megaptera novaenagliae*) abundance, distribution, and health in Hawaii and Alaska Meeting Report. Workshop, NOAA Fisheries Pacific Islands Regional Office, Honolulu, Hawaii, November.

Moran, J., and J. Straley. 2020. Humpback whale numbers have not recovered in Prince William Sound following the 2014 – 2016 marine heatwave. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Moran, J., and J. Straley. 2020. Observations on humpback whales in Prince William Sound and Southeast Alaska following a marine heatwave. SPLASH-2 Virtual Workshop, December.

Moran, J., and J. Straley. 2020. Observations on humpback whales in Prince William Sound and Southeast Alaska following a marine heatwave. US Biologically Important Areas II Startup Virtual Workshop, December.

Moran, J. R., J. M. Straley, O. von Zeigesar, T. Bare, A. Masterman, and L. Wild. 2022. The decline of humpback whales in Prince William Sound, Alaska following the 2014-2016 Northeast Pacific marine heatwave. Virtual oral presentation, Alaska Marine Science Symposium, January.

Murphy, H., and M. Arimitsu. 2022. Marine heatwaves and cold-spells: Persistent capelin stock collapses at opposite ends of the thermal optima. Keynote address, Capelin Symposium, Bergen, Norway, October.

Myers, H., and B. Konar. 2021. Listening for killer whales in Kachemak Bay. Virtual oral presentation, Kachemak Bay Science Conference, March.

Myers, H., D. Olsen, C. Matkin, and B. Konar. 2020. Resident killer whale (*Orcinus orca*) spatial use in the Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Myers, H., D. Olsen, C. Matkin, and B. Konar. 2020. Passive acoustic monitoring reveals year-round spatiotemporal distribution patterns of southern Alaska resident killer whales. Virtual oral presentation, Western Society of Naturalists Annual Meeting, November.

Myers, H., D. Olsen, C. Matkin, and B. Konar. 2021. Year-round habitat use and distribution patterns of killer whales in the northern Gulf of Alaska, as determined by passive acoustic monitoring. Virtual poster presentation, Alaska Marine Science Symposium, January.

Myers, H., D. Olsen, C. Matkin, and B. Konar. 2021. Unique distribution and acoustic residency patterns of sympatric mammal-eating killer whale populations in the Gulf of Alaska. Virtual oral presentation, Western Society of Naturalists Annual Meeting, November.

Norgaard, A. 2022. Inorganic carbon dynamics at the Gulf of Alaska ecosystem observatory. Virtual poster presentation, Alaska Marine Science Symposium, January.

O'Daly, S. 2022. The role of zooplankton in determining carbon export in the Gulf of Alaska. Virtual oral presentation, Alaska Marine Science Symposium, January.

O'Daly, S., S. Strom, and A. M. P. McDonnell. 2020. Particulate carbon flux, flux attenuation, and export efficiency in the summer of 2019 across the Northern Gulf of Alaska shelf. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

O'Hara, M. 2022. Cryptophyte distribution and mixotrophy in the Northern Gulf of Alaska. Virtual poster presented at the Alaska Marine Science Symposium, January.

O'Hara, M. 2022. Cryptophyte distribution and mixotrophy in the Subarctic Pacific Ocean. Virtual poster presentation, Ocean Sciences Meeting, February.

Olsen, D. 2017. Behavioral Changes during multi-pod Aggregations of Southern Alaska resident killer whales (*Orcinus orca*). Poster presentation, Society of Marine Mammalogy Conference, Halifax, Nova Scotia, Canada, November.

Olsen, D., C. Matkin, and K. Parsons. 2020. Characterization of killer whale (*Orcinus orca*) diet in the Northern Gulf of Alaska through genetic analysis of fecal samples. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Ortega, E. 2022. Temporal and spatial variability of particulate metals in the Northern Gulf of Alaska. Virtual oral presentation, Ocean Sciences Meeting, March.

Ostle, C., S. Batten, J. Fisher, D. Johns, B. Hunt, H. Melling, D. Moore, R. J. Nelson, and R. Stern. 2021. Extending the North Pacific Continuous Plankton Recorder Survey pole-ward through the Bering Sea into the Arctic and potential future investigations. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Ostle, C. and S. Batten. 2022. The North Pacific Continuous Plankton Recorder (CPR) Survey. University of Alaska Fairbanks, College of Fisheries and Ocean Sciences Seminar, Fairbanks, Alaska, February.

Pages, R. 2022. Long-term trends and compound events of ocean deoxygenation and acidification in the Gulf of Alaska. Virtual oral presentation, Alaska Marine Science Symposium, January.

Pages, R. 2022. Long-term trends and compound events of ocean deoxygenation and acidification in the Gulf of Alaska. Virtual oral presentation, Ocean Sciences Meeting, March.

Parrish, J. K., H. Burgess, T. Jones, J. Lindsey, A. Lestenkof, B. Bodenstein, B. Mangipane, E. Labunski, E. Lujan, H. Coletti, H. Renner, J. Christensen, J. Piatt, K. Hilwig, K. Lewandowski, K. Plentnikoff, K. Lefebvre, K. Kuletz, K. Griffin, L. Divine, L. Wilson, M. Romano, M. Cady, M. Good, M. Brubaker, N. Graff, N. Stellrecht, P. Lestenkof, P. Fitzmorris, P. Melovidov, R. Kaler, R. Corcoran, S. Schoen, S. Backensto, S. Knowles, S. Thomas, T. Mullet, C. Wright, A. Will and T. Lewis. 2020. Unabated mass mortality of marine birds in the northeast Pacific. Oral presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Pearson, H., S. Atkinson, J. Maselko, J. Moran, M. Rogers, and S. Teerlink. 2021. Humpback whales and tourism in Juneau, Alaska Establishing Baseline Measurements during the Covid 19 Pandemic. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Piatt, J., and M. Arimitsu. 2019. The ectothermic vise: regulation of seabirds by forage fish in hot water. Pacific Seabird Group meeting, Kauai, Hawaii, February.

Piatt, J., M. Arimitsu, S. Schoen, V. von Biela, J. Parrish, H. Renner. 2019. Mass mortality and breeding failure of seabirds during and after the 2014-2016 marine heatwave. Oral presentation, Joint American Fisheries Society-The Wildlife Society Meeting, Reno, Nevada, October.

Piatt, J., D. Douglas, M. Arimitsu, E. Madison, M. Kissling, and S. Schoen. 2020. Post-breeding migration of Kittlitz's Murrelets from the Gulf of Alaska to the Bering Sea and beyond. Oral presentation, Pacific Seabird Group Annual Meeting, Portland, Oregon, February.

Piatt, J., T. Jones, K. Kuletz, H. Renner, J. Parish, R. Corcoran, S. Schoen, B. Bodenstein, R. Kaler, M. Garcia-Reyes, H. Coletti, M. Arimitsu, R. Duerr, K. Lindquist, J. Lindsey, and W. Sydeman. 2018. Unprecedented scale of seabird mortality in the NE Pacific during the 2015-2016 marine heatwave. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Piatt, J. F., J. K. Parrish, H. M. Renner, S. K. Schoen, T. T. Jones, M. L. Arimitsu, K. J. Kuletz, B. Bodenstein, M. García-Reyes, R. S. Duerr, R. M. Corcoran, R. S. A. Kaler, G. J. McChesney, R. T. Golightly, H. A. Coletti, R. M. Suryan, H. K. Burgess, J. Lindsey, K. Lindquist, P. M. Warzybok, J. Jahncke, J. Roletto, and W. J. Sydeman. 2018. Unprecedented scale of seabird mortality in the NE Pacific during the 2015-2016 marine heatwave. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Piatt, J. J. K. Parrish, H. M. Renner, S. K. Schoen, T. T. Jones, M. L. Arimitsu, K. J. Kuletz, B. Bodenstein, M. García-Reyes, R. S. Duerr, R. M. Corcoran, R. S. A. Kaler, G. J. McChesney, R. T. Golightly, H. A. Coletti, R. M. Suryan, H. K. Burgess, J. Lindsey, K. Lindquist, P. M. Warzybok, J. Jahncke, J. Roletto, and W. J. Sydeman. 2019. Was an "ectothermic vise" responsible for the mass mortality and breeding failure of seabirds in Alaska following the NE Pacific marine heat wave of 2014-2016? Oral presentation, PICES annual meeting. Victoria, British Columbia, Canada, October.

Piatt, J. F., W. J. Sydeman, M. L. Arimitsu, and M. Garcia-Reyes. 2018. Extreme response of seabirds to extreme climate events in the NE Pacific. PICES Climate Change, Washington, D.C., June.

Reister, I. 2022. Fate of the Copper River plume. Virtual poster presentation, Alaska Marine Science Symposium, January.

Reister, I. 2022. Fate of the Copper River plume. Virtual poster presentation, Ocean Sciences Meeting, March.

Reister, I., and S. Danielson. 2021. Freshwater in the Northern Gulf of Alaska Marine Environment. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Renner, H. M., M. L. Arimitsu, D. E. Dragoo, H. F. Goyert, J. F. Piatt, and N. A. Rojek. 2017. Murre update: Widespread breeding failures following winter mortality event. Oral presentation, Pacific Seabird Group 44th Annual Meeting, Tacoma, Washington, February.

Renner, M., K. Holderied, C. McKinstry, D. Hondolero, and R. W. Campbell. 2021. Is it spring yet? Seasonal clusters of phyto- and zooplankton communities in Kachemak Bay and Lower Cook Inlet. Virtual poster presentation, Alaska Marine Science Symposium, January.

Renner, M., K. Holderied, J. Schloemer, S. Baird, and D. Hondolero. 2022. Timing of the phytoplankton spring bloom in Kachemak Bay. Oral Presentation. Alaska Marine Science Symposium, Virtual, January.

Robinson, C. L. K., D. F. Bertram, H. Shannon, V.R. von Biela, and M. Arimitsu. 2021. Haro Strait habitat as a refuge from ocean warming for Pacific sand lance and its importance to seabirds. World Seabird Conference, October.

Robinson, B., H. Coletti, B. Ballachey, J. Bodkin, G. Esslinger, and D. Esler. 2021. Spatial and temporal variation in nearshore marine bird communities in a warming Gulf of Alaska. Oral presentation, Alaska Bird Conference, Homer, Alaska, November.

Roncalli, V. 2017. The ecophysiology of a marine organism - a transcriptomic approach to diapause emergence. Invited presentation, Institut de Recerca de la Biodiversitat, University of Barcelona, Barcelona, Spain, July.

Roncalli, V. 2018. Physiological ecology of the calanoid *Neocalanus flemingeri* in the Gulf of Alaska. Invited presentation, Pacific Biosciences Research Center, University Hawaii Manoa, Honolulu, Hawaii, February.

Roncalli, V., M. Cieslak, A. M. Castelfranco, R. Hopcroft, D. K. Hartline, and P. Lenz. 2021. From suspended animation to fully active: Post-diapause transcriptomic restart in a high latitude zooplankter. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Roncalli, V., M. Cieslak, R. R. Hopcroft, and P. H. Lenz. 2019. Environmental heterogeneity in the Northern Gulf of Alaska impacts physiological status in the copepod, *Neocalanus flemingeri*. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Roncalli, V., M. C. Cieslak, P. H. Lenz, and R. R. Hopcroft. 2020. Energy allocation in a diapausing copepod: a transcriptomics analysis. Oral presentation, Ocean Sciences Meeting, San Diego, California, February.

Roncalli, V., M. C. Cieslak, S. A. Matthews, C. Clarke-Hopcroft, R. R. Hopcroft, and P. H. Lenz. 2017. Physiological changes in *Neocalanus flemingeri* females during the transition from diapause to reproduction. Oral presentation, Aquatic Sciences Meeting (ASLO), Honolulu, Hawaii, March.

Roncalli, V., M. C. Cieslak, S. A. Sommer, C. Clarke, P. H. Lenz, and R. R. Hopcroft. 2017. Transcriptomic changes in *Neocalanus flemingeri* from diapause emergence to egg production. Oral presentation, 13th International Conference on Copepoda, Los Angeles, California, July.

Roncalli, V., D. K. Hartline, M. Germano, M. C. Cieslak, S. L. Strom, R. R. Hopcroft, and P. H. Lenz. 2018. Consequences of regional heterogeneity on the physiology of a calanoid copepod, *Neocalanus flemingeri* in the northern Gulf of Alaska. Oral presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Sabo, A., D. R. Hardison, J. Matweyou., S. Kibler, C. Guo, X. Du., D. Hondolero, R. W. Campbell, B. Wright, W. C. Holland, and K. Holderied. 2022. Paralytic shellfish toxins in forage and predatory fishes of Southcentral and Southwest Alaska: NPRB 1801 Year 3 Update. Virtual poster presentation, Alaska Marine Science Symposium, January.

Schaefer, A. L., M. A. Bishop, and R. Thorne. 2018. Non-breeding marine bird response to forage fish schools in Prince William Sound, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Schaefer, A. L., M. A. Bishop, and R. Thorne. 2021. Marine bird response to forage fish during winter in bays of Prince William Sound, Alaska. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska January.

Schloemer, J. 2021. Cold winters temporarily cool an unusually warm ocean. Oral presentation. Kachemak Bay Science Conference, Homer, Alaska. February.

Schloemer, J., S. Baird, S. Bentz, M. Johnson, and R. Masui. 2019. Using circulation mapping and long-term water quality data to aid community monitoring programs in Kachemak Bay, Alaska. Poster presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Schloemer, J., J. Jenckes, M. Renner, and K. Holderied. 2022. Discharge-response timing: How long does it take for freshwater to travel through a high-latitude estuary? Oral presentation. Ocean Sciences Meeting, Honolulu, Hawaii, February.

Schoen, S., M. Arimitsu, J. Piatt, B. Heflin, C. Marsteller. 2019. Breeding failures of common murre and black-legged kittiwakes in Cook Inlet, Alaska following the North Pacific marine heat wave. Pacific Seabird Group meeting, Kauai, Hawaii, February.

Schoen, S. K., M. L. Arimitsu, J. F. Piatt, and C. E. Marsteller. 2020. Impact of the marine heatwave on seabird populations in Cook Inlet, Alaska. Oral presentation, Pacific Seabird Group Annual Meeting, Portland, Oregon, February.

Schoen, S., M. Arimitsu, J. Piatt, C. Marsteller, and S. Stark. 2022. Long-term impacts of the 2014-2016 North Pacific marine heatwave on seabirds in Alaska. Virtual oral presentation, Pacific Seabird Group Meeting, February.

Schoen, S., C. Van Hemert, W. Holland, J. Piatt, M. Arimitsu, J. Pearce, M. Smith, R. Hardison, S. Kibler. 2018. Harmful algal blooms and seabirds and forage fish: Assessment of tissues during and after the 2015-2016 seabird die-off. Pacific Seabird Group, La Paz, Mexico, February.

Sethi, S., K. Iken, B. Konar, and H. Coletti. 2018. Regional and local drivers combine to structure mussel growth and mortality. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Siegert, D., K. Iken, B. Konar, S. Saupe, and M. Lindeberg. 2018. Nearshore food web structure in two contrasting regions of Cook Inlet. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Siegert, D., K. Iken, S. Saupe, and M. Lindeberg. 2018. Nearshore food web structure in two contrasting regions of Cook Inlet. Oral presentation, CMI Annual Review, Anchorage, Alaska, January.

Siegert, D., K. Iken, S. Saupe, and M. Lindeberg. 2018. Nearshore food web structure in two contrasting regions of Cook Inlet. Poster presentation, Kachemak Bay Science Conference, Homer, Alaska, March.

Siegert, D., K. Iken, S. Saupe, and M. Lindeberg. 2019. Comparison of intertidal food web structure between two regions of lower Cook Inlet. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Siegert, D., K. Iken, S. Saupe, and M. Lindeberg. 2019. Comparing intertidal food web and community structure across two regions of lower Cook Inlet. Oral presentation. CMI Annual Review, Anchorage, Alaska, February.

Smoot, C., K. Coyle, and R. Hopcroft. 2020. Warm-water zooplankton in the Northern Gulf of Alaska: Observations from the Seward Line. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Stark, S., S. Schoen, C. Marsteller, M. Arimitsu, and J. Piatt. 2022. Identifying foraging hotspots and energy budgets of common murres and black-legged kittiwakes in Cook Inlet, Alaska. Virtual poster presentation. Pacific Seabird Group Meeting, February.

Stidham, E. 2021. Seasonal abundance and biomass of pelagic tunicates and snails in the Gulf of Alaska and Prince William Sound. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Stidham, E. 2022. Two-decades of observations on pelagic tunicates and pelagic snails in the Northern Gulf of Alaska (NGA). Virtual poster presentation, Alaska Marine Science Symposium, January.

Stidham, E. 2022. Two-decades of observations on pelagic tunicates and pelagic snails in the Northern Gulf of Alaska (NGA). Virtual oral presentation at the Ocean Sciences Meeting, March.

Straley, J. 2019. Observations of humpback whales in Alaska. Trends in Humpback Whales Meeting, Honolulu Hawaii, November.

Straley, J. 2019. Ecosystem implications for the decline in reproductive success in humpback whales in the Gulf of Alaska. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Straley, J., and J. Moran. 2018. Have Gulf of Alaska humpback whales reached carrying capacity or has the Blob made the food web screwy? Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Straley, J., and J. Moran. 2018. Have Gulf of Alaska humpback whales reached carrying capacity or has the Blob made the food web screwy? Poster presentation, Ocean Science Meeting, Portland, Oregon, February.

Straley, J., J. Moran, R. Suryan, M. Arimitsu, C. Gabriele, J. Neilson, and R. Cartwright. 2019. Understanding population-level changes in response to ecosystem perturbations: Humpback whale monitoring during the North Pacific Marine Heatwave. Oral presentation, Joint American Fisheries Society-The Wildlife Society Meeting, Reno, NV, October.

Straley, J., J. Moran, B. Witteveen, O. Titova, O. Filatova, C. Gabriele, J. Neilson, C. Matkin, O. von Ziegesar, and T. Cheeseman. 2020. Local collapse of a humpback whale population during the 2014-2016 marine heatwave: Where have all the whales gone? Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Strom, S. 2019. Mixotrophy in the Gulf of Alaska: Abundant plant-animal cells have major implications for ecology and biogeochemistry. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Strom, S., and S. Danielson. 2022. Ecological structure from a variable river plume in a productive marine setting. Poster presentation, LTER All Scientists Meeting, Asilomar, California, September.

Strom, S. L., and R. R. Hopcroft. 2018. Planktonic communities in the coastal Gulf of Alaska: strong dichotomies in structure and function. Oral presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Strom, S., R. R. Hopcroft, A. M. Aguilar-Islas, S. L. Danielson, and J. Fiechter. 2019. Resilience amidst a sea of change: the Northern Gulf of Alaska LTER program. Keynote presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Strom, S. L., R. R. Hopcroft, A. M. Aguilar-Islas, S. L. Danielson, J. Fiechter, A. M. P. McDonnell, and M. Sigman. 2018. The Northern Gulf of Alaska (NGA) LTER: Resilience amidst a sea of change. Poster presentation, LTER All Scientists' Meeting, Pacific Grove, California, March.

Strom, S. L., R. R. Hopcroft, K. O. Coyle, and S. L. Danielson. 2017. Three in a row: Continued warm conditions along the Gulf of Alaska's Seward Line. Oral presentation, Aquatic Sciences Meeting (ASLO), Honolulu, Hawaii, March.

Suitos, J. 2017. Genetic comparison between Prince William Sound and Alaska Coastal Current populations of a zooplankton species, the copepod *Neocalanus flemingeri*. Oral presentation, Undergraduate Research and Creative Work Symposium, University of Hawaii Manoa, Honolulu, Hawaii, May.

Suryan, R. M. 2018. Gulf of Alaska ecosystem variability. Oral presentation, Juneau Marine Naturalists Symposium. Juneau, Alaska.

Suryan, R. M. 2019. Mixed signals of "recovery" from the Gulf of Alaska marine heatwave: Perspectives from Gulf Watch Alaska. Oral presentation, University of Alaska Southeast, Juneau, Alaska.

Suryan, R. M. 2019. Gulf of Alaska ecosystem status for 2018 and early indicators for 2019. Oral presentation, Alaska Groundfish and Halibut Working Group, National Oceanic and Atmospheric Administration, Juneau, Alaska, March.

Suryan, R. M. 2019. Gulf Watch Alaska. Oral presentation to ecosystem-based fisheries management meetings and workshops within the National Oceanic and Atmospheric Administration, Integrated Ecosystem Assessment, Alaska Fisheries Science Center, including (1) Preview of Ecosystem and Economic Conditions workshop and (2) Ecosystem and Socioeconomic Profile workshop, Seattle, Washington.

Suryan, R. M., M. Arimitsu, H. Coletti, M. A. Bishop, D. Cushing, D. Esler, S. Hatch, D. Irons, R. Kaler, K. Kuletz, J. Piatt, and A. Schaefer. 2020 response of seabirds on colony and at sea to a prolonged marine heatwave in the Gulf of Alaska. Written presentation (tweets), 6th World Seabird Twitter Conference, May.

Suryan, R., M. Arimitsu, H. Coletti, R. Hopcroft, M. Lindeberg, S. Barbeaux, S. Batten, W. Burt, M. Bishop, J. Bodkin, R. Brenner, R. Campbell, D. Cushing, S. Danielson, M. Dorn, B. Drummond, D. Esler, T. Gelatt, D. Hanselman, S. Hatch, S. Haught, K. Holderied, K. Iken, D. Irons, A. Kettle, D. Kimmel, B. Konar, K. J. Kuletz, B. Laurel, J. M. Maniscalco, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, W. Palsson, S. Pegau, J. Piatt, L. Rogers, A. Schaefer, I. Spies, J. Straley, S. Strom, K. Sweeney, M. Szymkowiak, B. Weitzman, E. Yasumiishi, S. Zador. 2020. Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Panel, Science Synthesis Workshop, Anchorage, Alaska, February.

Suryan, R., M. Arimitsu, H. Coletti, R. Hopcroft, M. Lindeberg, S. Batten, J. Bodkin, M. Bishop, R. Campbell, D. Cushing, .S Danielson, D. Esler, S. Hatch, S. Haught, K. Holderied, K. Iken, D. Irons, R. Kaler, B. Konar, K. Kuletz, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, S. Pegau, J. Piatt, A. Schaefer, J. Straley, and B. Weitzman. 2019. Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska:

Seabirds are the tip of the iceberg. Oral presentation, The Wildlife Society and American Fisheries Society Conference, Reno, Nevada, September-October.

Suryan, R., M. Arimitsu, H. Coletti, R. Hopcroft, M. Lindeberg, S. Batten, J. Bodkin, M. A. Bishop, R. Campbell, D. Cushing, S. Danielson, D. Esler, S. Hatch, S. Haught, K. Holdereid, K. Iken, D. Irons, R. Kaler, B. Konar, K. Kuletz, C. Matkin, C. McKinstry, D. Monson, J. Moran, D. Olsen, S. Pegau, J. Piatt, A. Schaefer, J. Straley B. Weitzman. 2021. Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska: Seabirds are the tip of the iceberg. Virtual oral presentation, Third World Seabird Conference, October.

Suryan, R. M., and M. L. Lindeberg. 2020. Gulf Watch Alaska. Oral presentation to ecosystem-based fisheries management meetings and workshops within the National Oceanic and Atmospheric Administration, Integrated Ecosystem Assessment, Alaska Fisheries Science Center, including: (1) Preview of Ecosystem and Economic Conditions workshop, (2) Ecosystem and Socioeconomic Profile workshop, (3) Recruitment Processes Alliance annual meeting and strategic planning, Seattle, Washington.

Suryan, R., M. Lindeberg, D. Aderhold, M. Arimitsu, J. Piatt, J. Moran, J. Straley, H. Coletti, D. Monson, S. Hatch, T. Dean, R. Hopcroft, S. Batten, S. Danielson, B. Konar, K. Iken, B. Laurel, R. Campbell, and S. Pegau. 2018. Ecosystem variability and connectivity in the Gulf of Alaska following another major ecosystem perturbation. North Pacific Marine Science Organization (PICES) annual meeting, Yokohama, Japan, October-November.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Coletti, and R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Colletti, and R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Poster presentation, Kachemak Bay Science Conference, Homer, Alaska, March.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Colletti, and R. Hopcroft. 2018. Gulf Watch Alaska: Taking the pulse of the northern Gulf of Alaska. Poster presentation, Ocean Sciences Meeting, Portland, Oregon, February.

Suryan, R., M. Lindeberg, D. Aderhold, and K. Hoffman. 2020. Gulf Watch Alaska program science synthesis overview. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Panel, Science Synthesis Workshop, Anchorage, Alaska, February.

Suryan, R., M. Lindeberg, D. Aderhold, and K. Hoffman. 2020. GWA 2012-2019 highlights and wrap-up. Oral presentation, *Exxon Valdez* Oil Spill Trustee Council Science Panel, Science Synthesis Workshop, Anchorage, Alaska, February.

Suryan, R., M. Lindeberg, D. Aderhold, K. Hoffman, M. Arimitsu, H. Coletti, R. Hopcroft. 2019. Mixed signals of "recovery" from the Gulf of Alaska marine heatwave: Perspectives from Gulf Watch Alaska. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Suryan, R. M., M. R. Lindeberg, M. Arimitsu, H. Coletti, R. R. Hopcroft, D. Aderhold, and K. Hoffman. 2020. Ecosystem response to a prolonged marine heatwave in the Gulf of Alaska. Perspectives from Gulf Watch Alaska. Oral presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Suryan, R., S. Zador, M. Lindeberg, D. Aderhold, M. Arimitsu, J. Piatt, J. Moran, J. Straley, H. Colletti, D. Monson, S. Hatch, T. Dean, R. Hopcroft, S. Batten, S. Danielson, B. Konar, K. Iken, B. Laurel, R. Campbell, and S. Pegau. 2018. Ecosystem variability and connectivity in the Gulf of Alaska following another major ecosystem perturbation. Oral presentation, North Pacific Marine Science Organization (PICES) annual meeting, Yokohama, Japan, October-November.

Suryan, R., S. Zador, M. Lindeberg, M. Arimitsu, J. Piatt, J. Moran, J. Straley, H. Coletti, D. Monson, S. Hatch, T. Dean, R. Hopcroft, S. Batten, S. Danielson, B. Konar, K. Iken, B. Laurel, R. Campbell, M. Bishop, S. Schaeffer, S. Pegau, K. Kuletz, and R. Kaler. 2019. Ecosystem response to a marine heatwave in the Gulf of Alaska: seabirds are the tip of the iceberg. Pacific Seabird Group meeting, Kauai, Hawaii, February.

Sydeman, W. J., S. A. Thompson, M. Garcia-Reyes, M. Arimitsu, J. Piatt, H. Renner, S. Hatch. 2018. Puffins as samplers of forage fish in Alaska: variation in length and condition relative to ocean climate in the Gulf of Alaska. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Sydeman, W., S.A. Thompson, S. Zador, K. Shotwell, M. Arimitsu, H. Renner, J. Piatt, S. Hatch, and Y. Watanuki. 2019. Potential application of seabird data on groundfish stock assessments. Oral presentation, PICES annual meeting, Victoria, British Columbia, Canada, October.

Sztukowski, L. A., D. H. Monson, D. Esler, S. A. Sethi, H. A. Coletti, B. P. Weitzman, K. A. Kloecker, and T. E. Hollmen. 2017. Nearshore marine consumer responses to changing prey conditions: combining quantitative and qualitative model input into a conceptual framework. Oral Presentation. Alaska Marine Science Symposium, Anchorage, January.

Thompson, S. A., M. García-Reyes, W. J. Sydeman, M. L. Arimitsu, S. A. Hatch, and J. F. Piatt. 2019. Effects of ocean climate on the length and condition of forage fish in the Gulf of Alaska. Poster presentation, PICES annual meeting, Victoria, British Columbia, Canada, October.

Thompson, S. A., W. J. Sydeman, M. L. Arimitsu, J. Piatt, H. Renner, and S. Hatch. 2018. Morphometrics of forage fish sampled by puffins in Alaska: Describing the data. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Traiger, S. B., J. L. Bodkin, H. A. Coletti, B. Ballachey, T. Dean, D. Esler, K. Iken, B. Konar, M. R. Lindeberg, B. Robinson, R. M. Suryan, and B. Weitzman. 2020. How the mighty have fallen: Indirect effects of sea star wasting syndrome on mussel abundance in the Northern Gulf of Alaska. Oral Presentation. Western Society of Naturalists, November.

Traiger, S. B., J. L. Bodkin, H. A. Coletti, B. Ballachey, T. Dean, D. Esler, K. Iken, B. Konar, M. R. Lindeberg, B. Robinson, R. M. Suryan, and B. Weitzman. 2021. How the mighty have fallen: Indirect effects of sea star wasting syndrome on mussel abundance in the northern Gulf of Alaska. Oral Presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Traiger, S. B., J. L. Bodkin, H. A. Coletti, B. Ballachey, T. Dean, D. Esler, K. Iken, B. Konar, M. R. Lindeberg, B. Robinson, R. M. Suryan, B. Weitzman. 2021. How the mighty have fallen: Indirect effects of sea star wasting syndrome on mussel abundance in the northern Gulf of Alaska. Kachemak Bay Science Symposium, Homer, Alaska. March.

Turner, L., C. Cunningham, and M. Arimitsu. 2022. Combining forage fish datasets to understand spatial and temporal patterns for management. Oral presentation, American Fisheries Society Alaska Chapter, March.

Van Hemert, C., S. Schoen, W. Holland, J. Piatt, M. Arimitsu, J. Pearce, J., M. Smith, R. Hardison, and S. Kibler, S. 2018. Algal toxin assessments in seabird and forage fish tissues during the 2015-2016 seabird die-off. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Van Hemert, C., M. Smith, S. Schoen, R. Dusek, J. Piatt, M. Arimitsu, W. Litaker, J. Pearce. 2019. Harmful algal blooms in northern waters: an emerging issue for Alaskan seabirds? International Conference of the Wildlife Disease Association, Tahoe City, California, August.

von Biela, V., M. Arimitsu, J. Piatt, B. Heflin, S. Schoen, J. Trowbridge, and C. Clawson. 2019. Extreme reduction in nutritional value of a key forage fish during the Pacific Marine Heatwave of 2014-2016. Oral presentation, Joint American Fisheries Society-The Wildlife Society Meeting. Reno, Nevada, October.

von Biela, V. R., M. L. Arimitsu, S. K. Schoen, B. Heflin, and J. F. Piatt. 2018. Declining condition of a key forage fish in the Gulf of Alaska during the North Pacific marine heatwave. American Fisheries Society, Anchorage, Alaska, May.

von Biela, V, J. Piatt, M. Arimitsu, and L. Ball. 2019. Fish and wildlife responses to prolonged heatwaves: A window to the future? Symposium organizers, Joint American Fisheries Society-The Wildlife Society Meeting, Reno, Nevada, October.

Weiss, C., J. Moran, T. Miller, and M. Rogers. 2018. Fine-scale trophic ecology and bioenergetics of euphausiids in Prince William Sound, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

Weitzman, B. 2018. Assessing drivers of variability in macroinvertebrate abundance and productivity across the northeast Pacific. UAF College of Fisheries and Ocean Sciences Special Seminar, April.

Weitzman, B. 2019. Can you dig it? Patterns of variability in clam assemblages across the Gulf of Alaska. Oral presentation. UAF College of Fisheries and Ocean Sciences Special Seminar, Fairbanks, Alaska, February.

Weitzman, B. P., D. Esler, H. A. Coletti, B. Konar, T. A. Dean, J. L. Bodkin, K. Iken, A. K. Fukuyama, G. Shigenaka, and D. Lees. 2017. Can you dig it? Patterns of variability in clam assemblages within mixed-sediment habitats across the Gulf of Alaska. Oral Presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Weitzman, B., D. Esler, H. Coletti, B. Konar, and K. Iken. 2018. Can you dig it? Patterns of variability in clam assemblages within mixed-sediment habitats across the Gulf of Alaska. Oral Presentation. Kachemak Bay Science Conference, Homer, Alaska, March.

Weitzman, B., B. Konar, K. Iken, H. Coletti, D. Monson, R. M. Suryan, T. Dean, D. Hondolero, and M. R. Lindeberg. 2020. Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska. Oral presentation. *Exxon Valdez* Oil Spill Trustee Council Science Review Panel, Science Synthesis Workshop. Anchorage, Alaska, Feb. 27.

Weitzman, B., B. Konar, K. Iken, H. Coletti, D. Monson, R. Suryan, T. Dean, D. Hondolero, and M. Lindeberg. 2021. Baked Alaska: Changes in rocky intertidal community structure during a marine heatwave in the northern Gulf of Alaska. Kachemak Bay Science Symposium, Homer, Alaska, March.

Williamson, E., B. Konar, K. Iken, and M. K. McCabe. 2020. Size frequency distribution of *Mytilus trossulus* in Kachemak Bay. Poster Presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Zhang, B., B. Konar, B. Weitzman, H. Coletti, and D. Esler. 2020. Associating clam recruitment with adult standing stock in the northern Gulf of Alaska. Poster Presentation. Alaska Marine Science Symposium, Anchorage, Alaska, January.

Theses and dissertations

Blackmon, T. J. 2020. Growth of Pacific razor clams in Cook Inlet, Alaska. Dissertation, Alaska Pacific University, Anchorage, Alaska, USA.

Busse, H. 2021. Mixotrophy by phytoflagellates in the Northern Gulf of Alaska: Impacts of physico-chemical characteristics and prey concentration on feeding by photosynthetic nano- and dinoflagellates. Thesis, Western Washington University, Bellingham, Washington, USA. https://cedar.wwu.edu/wwuet/1005.

Chenoweth, E. M. 2018. Bioenergetic and economic impacts of humpback whale depredation at salmon hatchery release sites. Dissertation, University of Alaska Fairbanks, Fairbanks, Alaska.

Kandel, A. R. Y. 2020. Spatial and temporal variability of dissolved aluminum and manganese in surface waters of the Northern Gulf of Alaska, United States. Thesis, University of Alaska Fairbanks, Fairbanks, Alaska, USA. https://www.proquest.com/docview/2476549380/abstract/CD792F466B734239PQ/1.

Mendoza-Islas, H. 2020. Abundance, composition and distribution of predatory gelatinous zooplankton in the Northern Gulf of Alaska. Thesis, University of Alaska Fairbanks, Fairbanks, Alaska, USA. https://search.proquest.com/docview/2447028430.

Monell, K. J. 2020. Characterization of cell division in the tissues of the calanoid copepod, *Neocalanus flemingeri* from diapause through early oogenesis. Thesis, University of Hawai'i at Manoa, Manoa, Hawaii, USA. http://scholarspace.manoa.hawaii.edu/handle/10125/73356.

Mazur, C. M. 2020 Comparing the bioavailability of a natural and synthetic iron source: do past experiments accurately model phytoplankton response to episodic iron addition? Thesis, Western Washington University, Bellingham, Washington, USA. https://cedar.wwu.edu/wwuet/966/.

Pretty, J. L. 2019. Particles in the Pacific: how productivity and zooplankton relate to particles in the deep sea. Thesis, University of Alaska Fairbanks, Fairbanks, Alaska, USA. https://scholarworks.alaska.edu/handle/11122/10529.

Roberts, M. V. 2018. The temporal and spatial distribution of dissolved and particulate iron over the Gulf of Alaska shelf. Thesis, University of Alaska Fairbanks, Fairbanks, Alaska.

Outreach

Aderhold, D. 2017. Gulf Watch Alaska monitors ecosystem health. *Delta Sound Connections* 2017-18. 16 pp. Prince William Sound Science Center http://pwssc.org/wp-content/uploads/2017/06/DSC-2017-web2.pdf.

Aderhold, D. 2020. Scientists integrate studies of predators and prey in Prince William Sound. *Delta Sound Connections* 2020-21. 16 pp. Prince William Sound Science Center https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Aderhold, D. R. 2021. Gulf Watch Alaska program leads to understanding of species adaptation. *Delta Sound Connections* 2021-22. 16 pp. Prince William Sound Science Center https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Aderhold, D. 2022. Gulf Watch Alaska celebrates a decade of data! *Delta Sound Connections* 2022-23. 16 pp. Prince William Sound Science Center. https://pwssc.org/wp-content/uploads/2022/06/DSC-2022-WEB.pdf.

Aderhold, D., S. Buckelew, M. Groner, K. Holderied, K. Iken, B. Konar, H. Coletti, and B. Weitzman. 2018. Gulf Watch Alaska and Herring Research and Monitoring programs information exchange events with Alaska Native communities. Port Graham and Seldovia, May.

Alaska Fisheries Science Center. 2018. Dall's porpoise expands territory in a changing Prince William Sound. February 26, Feature Story, NOAA Fisheries website. https://www.fisheries.noaa.gov/feature-story/dalls-porpoise-expands-territory-changing-prince-william-sound.

Alaska Fisheries Science Center. 2021. Dall's porpoise research in Alaska. August 5, NOAA Fisheries website. https://www.fisheries.noaa.gov/alaska/marine-mammal-protection/dalls-porpoise-research-alaska.

Arimitsu, M. L. 2019. Forage fish in changing seas. Guest lecture at the Sitka Whalefest, a Community Science Symposium. Sitka, Alaska. November.

Arimitsu, M. 2019. Hands-on presentation about pelagic marine organisms in Prince William Sound to pre-school through high school students at Chenega School, September.

Arimitsu, M. L., J. F. Piatt, and S. Hatch. 2020. Forage fish in the Northern Gulf of Alaska: On the road to recovery at last? Delta Sound Connections. https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Arimitsu, M. L, J. F. Piatt, S. K. Schoen, and B. Heflin. 2017. Forage fish in hot water contribute to seabird die off in Prince William Sound. Delta Sounds Connections. http://pwssc.org/wp-content/uploads/2017/06/DSC-2017-web2.pdf.

Arimitsu, M., and S. Schoen mentored Alaska Native Science and Engineering Program student Tatiana Kortuas during field work in Prince William Sound in June-July 2019. Tatiana gained valuable experience while helping with marine ecosystem field research including

at-sea marine bird surveys, acoustic-trawl surveys for forage fish, zooplankton, and oceanography sampling.

Baily, A. 2021. UAF's Seward Marine Center celebrates 50 years, UAF press release, March.

Batten, S., S. Chiba, and W. Sydeman. 2020. Two decades of the North Pacific CPR program. PICES Press 28:18-21. https://meetings.pices.int/publications/pices-press/volume28/PPJan2020.pdf.

Bernton, H., and L. Mapes. 2019. It's been 30 years since the *Exxon Valdez* oil spill. Here's what we're still learning from that environmental debacle. Seattle Times, March 20 (Section based on killer whale project). https://meetings.pices.int/publications/pices-press/volume28/PPJan2020.pdf.

Campbell, R. W. 2017. Say cheese, plankton! A profiling plankton camera in Prince William Sound. PWSSC Delta Sound Connections. https://pwssc.org/wp-content/uploads/2017/05/DSC-2017.pdf.

Campbell, R. 2022. Are you ready for your close-up? Counting plankton with cameras. Delta Sound Connections 2022-2023 https://pwssc.org/wp-content/uploads/2022/06/DSC-2022-WEB.pdf.

Campbell, R. W., J. Jaffe, and P. L. Roberts. 2018. Photographing plankton. PWSSC Delta Sound Connections. http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf.

Campbell, R. W., J. Jaffe, and P. Roberts. 2019. Computers to identify plankton images from Prince William Sound. PWSSC Delta Sound Connections. https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf.

Campbell, R. W., J. Jaffe, and P. Roberts. 2020. Computers identify plankton images from Prince William Sound. PWSSC Delta Sound Connections. https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Campbell, R. W. 2021. Smile, you're on plankton cam! PWSSC Delta Sound Connections. https://pwssc.org/wp-content/uploads/2021/06/DSC-2021-LR.pdf.

Campbell, R. W., X. Du., and S. Kibler. 2021. Prevalence of paralytic shellfish toxins in Prince William Sound. PWSSC Delta Sound Connections. https://pwssc.org/wp-content/uploads/2021/06/DSC-2021-LR.pdf.

Coletti, H. 2021. Detecting and inferring cause of change in an Alaska nearshore marine ecosystem. OLE (Opportunities for Lifelong Education) Class: National Parks of Alaska. Presentation.

Coletti, H. 2021. Detecting and inferring cause of change in an Alaska nearshore marine ecosystem. Presentation to the Alyeska oiled wildlife training program.

Coos Bay World. 2017. Rapid declines of seabirds in Alaska linked to disappearing prey.

Corliss, K. 2022. Otoliths and marine food webs. BEST Homeschool Presentation.

Cornwall W. 2019. Ocean heat waves like the Pacific's deadly "Blob" could become the new normal. Science Magazine. January 31. https://www.sciencemag.org/news/2019/01/ocean-heat-waves-pacific-s-deadly-blob-could-become-new-normal?utm_campaign=NewsfromScience&utm_source=JHubbard&utm_medium=Twitter&fbclid=IwAR3QxH9cP6IWoqpwQp-HJ3BulkcFEaxvVntNM2zxlJNKRqkLtevn5kRnTjE.

Cushing, D. A. 2019. Seabirds and the Northern Gulf of Alaska Long Term Ecological Research Program. Guest Speaker, Eagle River High School Oceanography Classes (grades 10–12), Eagle River, Alaska.

Cushing, D., E. Labunski, and K. Kuletz. 2022. Summer tourists: The rare, amazing, and out-of-their-range visitors observed during seabird surveys in the northern Gulf of Alaska. Poster presentation. Pratt Museum Exhibit, Kachemak Bay Shorebird Festival, Homer, Alaska.

Danielson, S. L. 2020. The importance of University of Alaska-based monitoring of our oceans. Anchorage Daily News Op-Ed, 12 Dec. 2020. https://www.adn.com/opinions/2020/12/12/the-importance-of-university-of-alaska-based-monitoring-of-our-oceans/ (This was also a UAF press release and was re-printed in January 2021 by deltawindonline.com.)

Danielson, S. 2019. Assessing recent changes in Alaska region oceanic heat content. Osher Lifelong Learning Institute, Fairbanks, Alaska, October.

Danielson, S., R. Hopcroft, K. Holderied, and R. Campbell. 2019. Tracking water layers in the ocean. 2019-2020 Delta Sound Connections. https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf.

Danielson, S., H. Statscewhich, E. Farley, and J. Horne. 2022. Underwater glider makes first ever mid-winter voyage in the Gulf of Alaska. 2022-2023 Delta Sound Connections. https://pwssc.org/wp-content/uploads/2022/06/DSC-2022-WEB.pdf.

Fisher, J., D. Kimmel, T. Ross, S. Batten, E. Bjorkstedt, M. Galbraith, K. Jacobson, J. Keister, A. Sastri, K. Suchy, S. Zeman, and I. Perry. 2020. Copepod responses to, and recovery from,

the recent marine heatwave in the Northeast Pacific. PICES Press 28:68-71. https://meetings.pices.int/publications/pices-press/volume28/PPJan2020.pdf.

Flower-webdesign. 2017. Radio interview: Can sea stars make a comeback in Kachemak Bay? Alaska Public Media, August 15. https://alaskapublic.org/2017/08/15/can-sea-stars-make-a-comeback-in-kachemak-bay/.

Grove, C. 2021. Alaska's resident killer whales have a lot to say in underwater recordings. Alaska Public Media, December 7. https://alaskapublic.org/2021/12/07/alaskas-resident-killer-whales-have-a-lot-to-say-in-underwater-recordings/.

Gulf Watch Alaska Nearshore Team. 2018. Port Graham Native Corporation listening session, May 18th, 2018: Public discussion with elders. Port Graham, Alaska.

Gulf Watch Alaska Nearshore Team. 2019. Seldovia Community Science Presentations: Gulf Watch Alaska and associated project updates in Kachemak Bay and the Gulf of Alaska.

Hempsted, C. 2019. Seattle Aquarium biologist's blog documenting a Gulf Watch Alaska trip to Katmai NPP: https://www.seattleaquarium.org/blog/research-southwest-alaska-1.

Holderied, K. 2019. Kachemak Bay Oceanography. Oral presentation. Alaska Department of Fish and Game Alaska/West Coast Razor Clam Summit, Homer, Alaska, April.

Holderied, K. 2019. Kachemak Bay Research and Monitoring. Oral presentation. Cook Inlet Regional Citizens Advisory Council (CIRCAC) Environmental Monitoring Committee. Homer, Alaska, August.

Holderied, K., S. Baird, B. Konar and K. Iken. 2019. Kachemak Bay ecosystem monitoring. Public evening talk. Kachemak Bay Campus, Kenai Peninsula College, University of Alaska Anchorage, Homer, Alaska, October.

Holderied, K. 2019. Harmful algal blooms in Alaska. Oral presentation. Alaska Ocean Observing System Board of Directors, Anchorage, Alaska, December.

Krakow, M. 2020. A killer whale was headed toward a sea otter in Kachemak Bay. Then the otter hopped in a boat – and stayed there. Anchorage Daily News article interview, Anchorage, Alaska. https://www.adn.com/alaska-news/wildlife/2020/08/26/a-killer-whale-was-headed-toward-a-sea-otter-in-kachemak-bay-then-the-otter-hopped-on-a-boat-and-stayed-there/#:~:text=in%20new%20window)-,A%20killer%20whale%20was%20headed%20toward%20a%20sea%20otter%20in,a%20boat%20%E2%80%94%20and%20stayed%20there.&text=%E2%80%9CDude%2C%20that%20otter%20is%20in,fleeing%20a%20killer%20whale%20nearby.

Kaler. R. 2019. Status and trends of Pacific seabirds. Pacific Seabird Group Seabird Monitoring Committee Meeting, February.

Kaler, R. 2019. Sentinels of the Seas: Seabirds, die-offs, and ecosystem change. Invited presentation. University of Alaska Anchorage Environmental Studies Program, Anchorage, Alaska, November.

Kaler, R. 2020. Seabirds as sentinels, Parts 1 and 2. Invited presentation. Opportunities for Lifelong Education in Anchorage, Anchorage, Alaska, January.

Kaler, R. 2020. Alaska's ocean sentinels: Seabirds as ecosystem indicators in Prince William Sound. Oral presentation. Prince William Sound Natural History Symposium, Virtual, May.

Kaler, R. 2021. Marine bird research in Prince William Sound: Status and trends, guillemot restoration, and social attraction at seabird colonies. Oral presentation. Prince William Sound Natural History Symposium, Virtual, May.

Kaler, R. and R. Robinson. 2018. Alaska seabird mortality events and the die-off alert protocol. Presented at the Seldovia Tribal Government lunch hour, with partners from Gulf Watch Alaska and the Kachemak Bay Research Reserve, Seldovia, Alaska, May.

Konar, B., and K. Iken Lab. 2017. UAF Science Potpourri, April 2017: Public outreach event. Fairbanks, Alaska.

Kuletz, K., R. Kaler, and E. Labunski. 2021. Circumpolar Seabird Expert Group (CBird) Country Implementation Update (drafted sections on tufted puffin, Aleutian tern, black-legged kittiwake colony monitoring in PWS, and seabird mortalities). Virtual meeting.

Lindeberg, M. 2018. Lingering Oil from *Exxon Valdez* Spill - Long-term study of lingering oil from *Exxon Valdez* spill offers new insights for resource managers. Alaska Fisheries Science Center feature web story. Posted Feb 26. https://www.fisheries.noaa.gov/feature-story/lingering-oil-exxon-valdez-spill.

Lindeberg, M. 2018. A wealth of scientific information, decades in the making - a recent special issue journal highlights the status of an Alaska marine ecosystem more than a quarter century after the *Exxon Valdez* oil spill. Alaska Fisheries Science Center feature web story. Posted Feb. 26. https://www.fisheries.noaa.gov/feature-story/wealth-scientific-information-decades-making.

Lindeberg, M., and J. Moran. 2018. Dall's porpoise expands territory in a changing Prince William Sound: territory increases as killer whale population dwindles. Alaska Fisheries Science Center feature web story. Posted Feb 26. https://www.fisheries.noaa.gov/feature-story/dalls-porpoise-expands-territory-changing-prince-william-sound.

Lindeberg, M. R. 2019. Gulf Watch Alaska: A long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council. North Pacific Fishery Management Council, Homer, Alaska, Oct. 3.

Lindeberg, M. R. 2019. Gulf Watch Alaska: A long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council. Evening public lecture series. Kachemak Bay Campus, Kenai Peninsula College, University of Alaska Anchorage. Oct. 8.

Lindeberg, M. R. 2020. Gulf Watch Alaska: A long-term monitoring program of the *Exxon Valdez* Oil Spill Trustee Council. Oral presentation. EVOSTC Public Meeting, Anchorage, Alaska, virtual, Oct. 14.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter. Volume 1.1: spring quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter. Volume 1.2: summer quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter. Volume 1.3: fall quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2017. GWA Quarterly Currents. Newsletter. Volume 1.4: winter quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.1: spring quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.2: summer quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.3: fall quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2018. GWA Quarterly Currents. Newsletter. Volume 2.4: winter quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2019. GWA Quarterly Currents. Newsletter. Volume 3.1-3.2: spring-summer quarters. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2019. GWA Quarterly Currents. Newsletter. Volume 3.3: fall quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2019. GWA Quarterly Currents. Newsletter. Volume 3.4: winter quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2020. GWA Quarterly Currents. Newsletter. Volume 3.1: spring quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2020. GWA Quarterly Currents. Newsletter. Volume 3.2: summer quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2020. GWA Quarterly Currents. Newsletter. Volume 3.3: fall quarter. Link on gulfwatchalaska.org.

Lindeberg, M., K. Hoffman, R. Suryan, and D. Aderhold. 2020. GWA Quarterly Currents. Newsletter. Volume 3.4: winter quarter. Link on gulfwatchalaska.org.

Lindeberg, M., and R. Heintz. 2019. 30 years since the Exxon Valdez oil spill: An era of scientific research and monitoring that has changed our understanding of oil spill impacts. *Delta Sound Connections* 2019-20. 16 pp. Prince William Sound Science Center. http://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf.

Matkin, C. 2018. Life History and Social Structure of Alaskan Killer Whales. Kenai Peninsula College, September.

Matkin, C. 2019. Cetaceans of Southern Alaska. University of Alaska Anchorage course. Series of Oral Presentations, May-June.

Matkin, C. 2019. Killer whales in Prince William Sound and continuing effects of the *Exxon Valdez* oil spill. Oral presentation. Kenai Peninsula College, September.

Matkin, C. 2019. Killer whales and research in Alaska. Film production to be shown on Princess Cruises in Alaska. Mike Valente, Faculty NY, producer, Anchorage, April.

Matkin, C. 2020. Aspects of killer whale biology in Prince William Sound/Kenai Fjords and continuing effects of the *Exxon Valdez* oil spill. Oral presentation. Kenai Peninsula College, September.

McKinstry, C. 2018. Microscopic tourists. PWSSC Delta Sound Connections. http://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf.

McKinstry, C. 2022. Warm waters have impact on tiniest Cook Inlet residents. Delta Sound Connections 2022-2023 https://pwssc.org/wp-content/uploads/2022/06/DSC-2022-WEB.pdf.

Moran, J. 2018. What predators tell us about prey? Juneau Marine Naturalist Symposium. Juneau, Alaska. May 10.

Moran, J. 2018. Dall's porpoise: Life in the fast lane. Delta Sound Connections 2018-2019. https://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf.

Moran, J. 2020. What happened to the whales? Delta Sound Connections 2020-2021. https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Moran, J. 2020. What happens in Alaska doesn't stay in Alaska. Whale Tales, Kapalua, Hawaii, February 14-17.

Moran, J. 2020. Large whale entanglements in Alaska and fisheries interactions. University of Alaska College of Fisheries and Ocean Sciences seminar series. Juneau, Alaska, March 6.

Moran, J. 2020. Large whale entanglements in Alaska and fisheries interactions. University of Alaska Southeast marine mammal class. Juneau, Alaska, April 7.

Moran, J. 2020. How are the whales responding to fewer tourists in the waters off Juneau, AKL Summer survey underway to learn more – Post 1. NOAA Fisheries Science Blog. https://www.fisheries.noaa.gov/science-blog/how-are-whales-responding-fewer-tourists-waters-juneau-ak-summer-survey-underway-learn.

Moran, J. 2020. Global check in speaker. Whale Tales. https://www.whaletales.org/.

Moran, J., and M. Arimitsu. 2019. Presentation on whales and forage fish. Chenega Bay School, September 20. Both students and members of the public attended.

Moran, J., and M. Lindeberg. 2021. Oil Spill Tabletop Exercise for Prince William Sound. Alaska Marine Mammal Natural Resource Damage Assessment (NRDA), April 6, 14, and 22.

Myers, H. 2021. Mentor to University of Alaska Fairbanks undergraduate student conducting research on Gulf of Alaska transient killer whale vocal behavior.

Nicklin, F. 2020. Humpback chronicles, episode 39 – John Moran. Whale Trust. https://www.youtube.com/watch?v=FDNZk0Np64k.

NOAA. 2018. Science and Stewardship: Keys to restoring Kachemak Bay (video). NOAA National Marine Fisheries Service, July. https://coastalscience.noaa.gov/news/kachemak-bay-hfa-video/.

NOAA-NCCOS. 2019. "State of Kachemak Bay" 2019. https://cdn.coastalscience.noaa.gov/projects-attachments/396/StateofKachemakBay_2019Highlights.pdf.

NOAA-NCCOS. 2020. "State of Kachemak Bay" 2020. https://cdn.coastalscience.noaa.gov/projects-attachments/369/2020_StateofKachemakBay_HighRes_Finalv8.pdf.

NOAA-NCCOS. 2021. “State of Kachemak Bay” 2021. https://cdn.coastalscience.noaa.gov/projects-attachments/369/KachemakBay_StateoftheBay2021.pdf.

NOAA-NCCOS. 2021. Sea Otter Story Map. https://arcg.is/04eTmO.

NPS. 2018. Mussel Abundance in the Gulf of Alaska. https://www.nps.gov/articles/musselabundance.htm.

NPS. 2018. Sea Otter Monitoring in Southwest Alaska. NPS Resource Brief. https://www.nps.gov/articles/sea-otter-swan-parks.htm.

NPS. 2018. What do Black Oystercatcher chicks eat? https://www.nps.gov/articles/bloychickdiet.htm.

NPS. 2019. Future Directions in Sea Otter Research and Management. https://www.nps.gov/articles/seaotterresearchmanagement.htm.

NPS. 2019. Improving Mussel Monitoring. https://www.nps.gov/articles/musselgenes.htm.

NPS. 2019. Sea Star Assemblages Changed After Wasting Disease. https://www.nps.gov/articles/seastarchanges.htm.

NPS. 2020. How Marine Heatwaves and Changing Ocean Ecosystems. https://www.nps.gov/articles/000/heatwavestorymap.htm.

NPS. 2020. Marine Heatwave linked to Seabird Die-off. https://www.nps.gov/articles/blametheblob.htm.

NPS. 2020. Monitoring Nearshore Marine Systems. 2020. NPS Resource Brief. https://www.nps.gov/articles/nearshore2020.htm.

NPS. 2020. Monitoring Razor Clams as an Indicator of Nearshore Ecosystem Health. https://www.nps.gov/articles/razorclams.htm.

NPS. 2021. Effects Continue from the Pacific Marine Heatwave. https://www.nps.gov/articles/000/marineheatwaveimpacts.htm.

NPS. 2021. NPS Alaska Seabird die-off page with links to videos and story maps as well as annual summaries: https://www.nps.gov/subjects/aknatureandscience/alaskaseabirddieoffs.htm.

NPS. 2021. Using Gene Expression to Investigate Differences Between Clam Populations. https://www.nps.gov/articles/000/clamgenes.htm.

NPS. 2021. Why did the southwest Alaska sea otter population collapse? https://www.nps.gov/articles/000/swakseaottercollapse.htm.

Olsen, D. 2017. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral presentation, January.

Olsen, D. 2017. Killer whales of Kenai Fjords. Seward Captain and naturalist training, Seward, Alaska. Oral presentation, May.

Olsen, D. 2018. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral presentation. January.

Olsen, D. 2018. Killer whales of Kenai Fjords. Seward Captain and naturalist training, Seward, Alaska. Oral presentation, May.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Kenai Fjords National Park training, May.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Prince William Sound Science Center Brown Bag, May.

Olsen, D. 2018. Mom knows best: Killer whale culture in Southern Alaska. Kayak Adventures guide training, May.

Olsen, D. 2018. Killer whales of the world. Zegrahm Expeditions, July.

Olsen, D. 2018. Life of the Killer Whale. Seabourne Sojourn, August.

Olsen, D. 2018. Mom knows best: Killer whale culture in Prince William Sound. Kenai Peninsula College, September

Olsen, D. 2019. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral presentation, February.

Olsen, D. 2019. Killer whales of Southern Alaska. Seward naturalists and boat operators, Seward, Alaska. Oral presentation, May.

Olsen, D. 2019. Mom knows best: Killer whale culture in Southern Alaska. Kayak Adventures Worldwide guide training, Seward, Alaska. Oral presentation, May.

Olsen, D. 2019. Killer whales of Kenai Fjords. Kenai Fjords National Park interpretive staff training, Seward, Alaska. Oral presentation, May.

Olsen, D. 2019. Killer Whale Acoustic Identification. Kenai Fjords National Park staff and general Seward naturalists. Seward, Alaska. Oral presentation, June.

Olsen, D. 2019. Killer whales of Alaska. Lindblad Expeditions, Southeast Alaska. Oral presentation, July.

Olsen, D. 2019. Killer whales of Prince William Sound. Chenega School, Chenega, Alaska. Oral presentation, September.

Olsen, D. 2019. Acoustics of killer whales and other marine mammals. Kenai Peninsula College, Homer, Alaska. Oral presentation, November.

Olsen, D. 2020. Killer whales of the world. Zegrahm Expeditions, Antarctica. Oral presentation, January.

Olsen, D. 2020. Killer whales of Kenai Fjords. Kayak Adventures Worldwide guide training, Seward (Zoom), Alaska. Oral presentation, May.

Olsen, D. 2020. Mother knows best: Killer whale culture and generational learning. U.S. Forest Service PWS Natural History Symposium, Whittier (Zoom), Alaska. Oral presentation. May 2020.

Olsen, D. 2020. Killer whales of Kenai Fjords. Seward Captain and naturalist training, Seward, Alaska. Oral presentation, May.

Olsen, D. 2020. Killer whales of Kenai Fjords. Wildlands Studies, Seward (outdoor), Alaska. Oral presentation, August.

Olsen, D. 2020. Acoustics of killer whales and other marine mammals. Kenai Peninsula College, Homer (Zoom), Alaska. Oral presentation, October.

Olsen, D. 2020. Mom knows best: Killer whale culture. Sitka Whalefest, Sitka (Zoom), Alaska. Oral presentation. November.

Pinchin, K. 2022. Protecting people from deadly shellfish. Scientific American 326:56-69. doi:10.1038/scientificamerican0122-56. https://www.scientificamerican.com/article/these-shellfish-could-kill-you/.

Robinson, B. 2019. Movement, migration, monitoring: The Black Oystercatcher. Gulf Watch Alaska Public Outreach Event. Homer, Alaska. Presentation.

Rozell, N. 2021. Killer conversations: UAF grad student keeps track of orca whale communications with underwater microphones. Anchorage Daily News, November 20. https://www.adn.com/alaska-news/science/2021/11/20/killer-conversations-uaf-grad-student-keeps-track-of-orca-whale-communications-with-underwater-microphones/.

Rozell, N. 2021. The voices of killer whales. Fairbanks Daily News-Miner. November 21. https://www.newsminer.com/features/sundays/alaska_science_forum/the-voices-of-killer-whales/article_9c9855fc-48dd-11ec-926d-4f4d32c1af1c.html.

Rozell, N. 2021. Calls of killer whales with Hannah Myers. Alaska Science Pod, December 7. https://podcasts.apple.com/us/podcast/ep-7-calls-of-killer-whales-with-hannah-myers/id1565919069?i=1000544238117.

Schaefer, A. L. 2018. A winter refuge for seabirds. 2018-2019 Delta Sound Connections, Cordova, Alaska. https://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf.

Schaefer, A. L. 2020. Are warmer waters driving shearwaters into PWS? 2020-2021 Delta Sound Connections, Cordova, Alaska. https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Schaefer, A. L. 2021. Marine bird predators work smarter, not harder. 2021-2022 Delta Sound Connections, Cordova, Alaska. https://pwssc.org/wp-content/uploads/2020/07/DSC-2020-web.pdf.

Suryan, R. M. 2018. Gulf Watch Alaska: Why we study ecosystems. Oral presentation. Juneau Yacht Club, Juneau, Alaska.

Suryan, R. M. 2018. Gulf Watch Alaska looks beyond "the Blob". *Delta Sound Connections* 2018-2019. 16 pp. Prince William Sound Science Center. https://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf.

Suryan, R. M. 2019. Changing climate, changing ecosystems. Sitka WhaleFest public presentation, Sitka, Alaska.

Suryan, R. M. 2019. Forage fish in hot water. Conservation Connection Podcast. https://www.lastchanceendeavors.com/podcast/episode/2183620a/rob-suryan-research-ecologist-at-whalefest-2019-or-forage-fish-in-hot-water-or-episode-026.

Suryan, R. M. 2019. Biological response to a marine heatwave in the Gulf of Alaska. Evening public lecture series. Oral presentation. Kachemak Bay Campus, Kenai Peninsula College, University of Alaska Anchorage. Oct. 8.

Suryan, R. M. 2022. Changes in marine subsistence species abundance following the Pacific marine heatwave. Chugach Regional Resources Commission 20th Annual Gathering. March 24.

Suryan, R., S. Batten, R. Campbell, and S. Danielson. 2019. What does the future hold for the Gulf of Alaska? *Delta Sound Connections* 2019-20. 16 pp. Prince William Sound Science Center. http://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf.

Traiger, S. 2021. Mussels are thriving; Thank your (un)lucky stars. 2021-2022 Delta Sound Connections. https://pwssc.org/wp-content/uploads/2021/06/DSC-2021-LR.pdf.

Traiger, S. 2021. A tale of two nearshore disturbances. State of Kachemak Bay Report. https://cdn.coastalscience.noaa.gov/projects-attachments/369/KachemakBay_StateoftheBay2021.pdf.

Weitzman, B. 2018. Unhappy as a clam? 2018-2019 Delta Sound Connections. https://pwssc.org/wp-content/uploads/2018/05/DSC-2018-FINAL_WEB.pdf.

Weitzman, B. 2018. Sea otter biology and ecology across the north Pacific. Glacier Bay National Park Service, Ranger Training Series, April.

Weitzman, B. et al. 2019. Kachemak Bay National Estuarine Research Reserve Lecture Series: Sea otter and clam population dynamics in Kachemak Bay, Homer, Alaska.

Weitzman, B. 2019. Monitoring Coastal Ecosystems in the Gulf of Alaska. Fireweed Academy Lecture, Homer, Alaska, December.

Yelverton, J. 2020. The fragile world of Prince William Sound. Anchorage Press (cover story, Jan 29). https://www.anchoragepress.com/news/the-fragile-world-of-prince-william-sound/article_67b68770-413f-11ea-97fc-9f581d3d2d77.html.

Turns, A. 2020. Tiny plankton tell the ocean's story – this vast marine mission has been listening. The Guardian. https://www.theguardian.com/environment/2020/jun/19/tiny-plankton-tell-the-oceans-story-this-vast-marine-mission-has-been-listening.

Online resources

Alaska Ocean Observing System Gulf of Alaska Data Portal (Gulf Watch Alaska data): https://gulf-of-alaska.portal.aoos.org/#search?type_group=all&tag|tag=evos-gulf-watch-projects&page=1.

Gulf Watch Alaska: https://gulfwatchalaska.org/.

Herring Research and Monitoring: https://pwssc.org/herring/.